Original Research Article

Influence of plant growth regulator (TA-41) on growth and yield of wheat (*Triticum aestivum* L.)

Abstract

A field experiment was carried out during *rabi* season of 2021, at crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India. The experiment was entitled as "Influence of plant growth regulator (TA-41) on growth and yield of wheat (*Triticum aestivum* L.)". The experiment was laid out in randomized block design (RBD) which consisted of seven treatments and replicated thrice viz., T_1: Control (No application), T_2: TA-41 at 5.0 liter in 200 liter of water in 1 hectare, T_3: TA-41 at 7.5 liter in 200 liter of water in 1 hectare, T_4: TA-41 at 10.0 liter in 200 liter of water in 1 hectare, T_5: TA41 at 200 ml in 15 liter of water [full tank], T_6: TA41 at 300 ml in 15 liter of water [full tank] and T_7: TA41 at 400 ml in 15 liter of water [full tank]. The result of experiment showed that growth parameters viz., plant height (90.77 cm) significantly higher in treatment T_2 with application of TA-41 at 5.0 liter in 200 liter of water in 1 hectare and dry weight (17.73 g), number of spikes/m^2 (442.67), grains/spike (55.56), grain yield (6.88 t/ha) and straw yield (15.7 t/ha) were recorded significantly maximum in treatment T_7 with application with TA-41 at 400 ml in 15 liters of water [full tank]. Maximum gross returns (1,85,732.00 INR./ha), net returns (1,32,637.47 INR./ha) and benefit: cost ratio (2.5) were also obtained highest in treatment T_7 with application with TA-41 at 400 ml in 15 liters of water [full tank].

Keywords: Wheat, plant growth regulator (TA-41), growth parameters, yield attributes, yield and economics.

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INTRODUCTION

Wheat *(Triticum aestivum L.)* is one of the most important cereal crop belongs to *Poaceae* family and staple food crop of the world and emerged as the backbone of India's food security. Wheat is

also called as "King of Cereals". Wheat possess 2n = 42 chromosomes with self-pollination as a mode of pollination. It is a C_3, long day and hexaploid plant. Wheat is one of the second most significant cereals in India following rice, contributing substantially to the national food security by providing more than 50% of the calories to the people who mainly depend on it. For the last several years India is the 2nd largest producer of wheat in the world next to China (FAO). It is grown all over the world for its wider adaptability and high nutritive value. It is an important winter cereal contributing about 38% of the total food grain production in India. Wheat straw is an important source of fodder for a large Indian animal population. Wheat and rice serve as life sustaining crops for maximum population and thus, considered to be the backbone of nation's food security system.

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The use of plant growth regulators may be one of the best possible ways to achieve spectacular progress in crop production and productivity. Exogenous application of plant growth regulators offer unique opportunities of scaling plants to any size and alter physiological processes in the plant to increase seed yield and quality. Partitioning of dry matter to seeds is considered to be a major determinant for agricultural yield. This is dependent on the efficiency of photosynthates translocation in crop during grain filling period when developing grains are the storing sink. It has been reported that plant growth regulators plays important role in greater partitioning of photosynthates towards reproductive sink thereby, improving the harvest index. Plant growth regulators are biochemical compounds which stimulates plant growth and productivity when applied, even in small quantities at appropriate plant growth stages. These are being extensively used in agriculture to enhance the productivity in field crops. Their central role in plant growth and development is through nutrient allocation and source-sink transitions. Since climate change and degrading natural resources are projected to amplify the stresses, particularly soil moisture deficit, high temperature and soil salinity. Plant growth regulators are likely to play a crucial role in plant growth regulation.

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MATERIALS AND METHODS

During *rabi* season of 2021, a field experiment was conducted ~~out~~ at the Crop Research Farm of the Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (Allahabad) U.P. in alluvial soil. Soil of experimental plot was sandy loam, having nearly neutral soil reaction (pH -6.9), electrical conductivity (0.29 ~~ds~~dS/m), available nitrogen (278.93 kg/ha), available phosphorous (10.8 kg/ha) and available potassium (206.4 kg/ha). Test variety (DBW 187) was sown on 3rd week of November 2021 with a spacing of 22.5 x 5 cm. The experiment was conducted in Randomized Block Design consisting of 7 treatment combinations with 3 replications and was laid out with the different treatments allocated randomly in each replication. Fertilizers were applied as band placement, for which 4-5 cm deep furrows were made along the seed rows with a hand hoe. The nutrient sources were urea, single super phosphate (SSP), and murate of potash (MOP). The recommended dose of fertilizers in the ratio of 120:60:40 kg N:P:K/ ha was applied according to the treatment details. After germination, the gaps were filled up by dibbling of seed at 10 DAS. Seedlings were thinned out in order to maintain spacing of 22.5 x 5 cm. Manual weeding was done with the help of khurpi at 30 and 45 days after sowing to minimize the crop weed competition. Application of TA-41 was applied two times through soil drenching and foliar spray at tillering and booting stages. The field was maintained in a moist condition and for this, four irrigations were provided, one as pre sowing and other at growth stages. The crop was harvested separately from each plot taking 1.0 m^2 area on March 23rd 2022, i.e., 123 DAS. Thereafter, the produce from net plot was tied in bundles separately and then tagged. The tagged bundles were allowed for sun drying in field and after drying on the threshing floor, the weight of bundles was recorded for obtaining biological yield. Threshing of wheat was done manually by beating with stick and then seeds were separated by winnowing.

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Results and Discussions

Influence of plant growth regulator (TA-41) on plant height of wheat.

Growth parameters are important when assessing plant growth because a plant's height is a measure of its vegetative growth which directly relates to biological yield (grain + straw). Among all the treatments, in treatment 2 with application of TA-41 at 5.0 liter in 200 liter of water in 1 hectare was found significantly superior (Table 1). At 100 DAS, maximum higher plant height (90.77 cm) was recorded in treatment T_2 with application of TA-41 at 5.0 liter in 200 liter of water in 1 hectare as compared with other treatments. However, treatment T_4 with application of TA-41 at 10.0 liter in 200 liter of water in 1 hectare and treatment T_5 with of application TA-41 at 200 ml in 15 ~~liter~~liters of water [full tank] were statistically at par with treatment T_2 with application of TA-41 at 5.0 liter in 200 liter of water in 1 hectare. This is due to retardant properties of plant growth regulators results a significant reduction in plant height during the entire growing season. The use of growth regulators at the end of the tillering exit into the tube phase reduced the height of plants.

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Table 1: Influence of plant growth regulator (TA-41) on plant height of wheat

Treatment Symbols	Treatments	Plant height (cm)				
		20 DAS	40 DAS	60 DAS	80 DAS	100 DAS
T_1	Control (without any treatment)	3.93	14.17	44.99	86.49	89.68
T_2	TA-41 at 5.0 liter in 200 liter of water in 1 hectare	4.48	14.26	41.38	86.49	90.77
T_3	TA-41 at 7.5 liter in 200 liter of water in 1 hectare	4.25	14.43	40.47	87.44	89.90
T_4	TA-41 at 10.0 liter in 200 liter of water in 1 hectare	4.18	14.53	40.31	85.00	90.39
T_5	TA-41 at 200 ml in 15 liters of water [full tank]	4.42	14.49	40.87	89.73	90.10
T_6	TA-41 at 300 ml in 15 liters of water [full tank]	4.08	13.99	39.24	86.51	89.50
T_7	TA-41 at 400 ml in 15 liters of water [full tank]	3.97	14.82	40.02	86.13	88.57
	F test	NS	NS	S	S	S
	SEm±	0.27	0.63	1.07	0.83	0.32
	CD (P= 0.05)	-	-	3.29	2.55	1.00

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Influence of plant growth regulator (TA-41) on dry weight of wheat.

Maximum plant dry weight (17.73 g) was recorded in treatment 7 with application of TA-41 at 400 ml in 15 ~~liter~~liters of water [full tank] as compared with other treatments (Table 2). However, treatment 6 with application of TA-41 at 300 ml in 15 ~~liter~~liters of water [full tank] was statistically at par with treatment 7 with application of TA-41 at 400 ml in 15 ~~liter~~liters of water [full tank]. The highest dry weight was recorded in the maturity stage due to the mass accumulation of the crop and also the dry weight increased with application of plant growth regulator, might be due to the better growth of healthy seedlings. The similar findings were reported by Kumar and Yadav (2005), and Kumar *et al.* (2007).

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Table 2: Influence of plant growth regulator (TA-41) on dry weight/plant of wheat.

Treatment Symbols	Treatments	Dry weight (g)				
		20 DAS	40 DAS	60 DAS	80 DAS	100 DAS
T_1	Control (without any treatment)	0.19	1.38	4.22	13.90	14.57
T_2	TA-41 at 5.0 liter in 200 liter of water in 1 hectare	0.26	1.50	4.79	14.23	15.52
T_3	TA-41 at 7.5 liter in 200 liter of water in 1 hectare	0.30	1.73	5.46	14.49	16.19
T_4	TA-41 at 10.0 liter in 200 liter of water in 1 hectare	0.31	1.89	5.94	14.60	16.38
T_5	TA-41 at 200 ml in 15 ~~liter~~liters of water [full tank]	0.33	1.74	5.59	14.56	16.09
T_6	TA-41 at 300 ml in 15 ~~liter~~liters of water [full tank]	0.42	2.00	6.51	15.05	16.66
T_7	TA-41 at 400 ml in 15 ~~liter~~liters of water [full tank]	0.44	2.37	6.43	16.26	17.73
	F test	NS	S	S	S	S
	SEm±	0.06	0.13	0.30	0.44	0.40
	CD (P= 0.05)	-	0.39	0.94	1.35	1.24

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Table 3: Influence of plant growth regulator (TA-41) on yield attributes and yield of wheat.

Treatment Symbols	Treatments	No. of spikes	No. of grains/spike	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Harvest Index (%)
T_1	Control (without any treatment)	347.33	42.52	34.67	4.42	11.05	28.63
T_2	TA-41 at 5.0 liter in 200 liter of water in 1 hectare	380.00	45.91	35.00	5.18	12.17	29.94
T_3	TA-41 at 7.5 liter in 200 liter of water in 1 hectare	405.00	47.59	37.33	5.53	12.18	31.23
T_4	TA-41 at 10.0 liter in 200 liter of water in 1 hectare	405.33	53.67	39.67	6.27	12.87	34.88
T_5	TA-41 at 200 ml in 15 ~~liter~~liters of water [full tank]	381.00	49.78	37.67	6.22	12.72	32.84
T_6	TA-41 at 300 ml in 15 ~~liter~~liters of water [full tank]	437.33	54.48	38.67	6.45	12.92	33.53
T_7	TA-41 at 400 ml in 15 ~~liter~~liters of water [full tank]	442.67	55.56	40.33	6.88	15.70	29.71
	F test	S	S	NS	S	S	NS
	SEm±	19.19	2.51	1.47	0.32	0.08	2.23
	CD (P= 0.05)	19.14	7.73	-	0.99	0.26	-

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Influence of plant growth regulator (TA-41) on yield attributes and yield of wheat.

Number of spikes/m^2

Number of effective spikes/m^2 showed significant difference among all treatments. Whereas, maximum number of effective spikes/m^2 (442.67) was observed in treatment 7 with application of TA-41 at 400 ml in 15 liter of water [full tank] except in treatment 6 with application of TA-41 at 300 ml in 15 liter of water [full tank] was found to be statistically at par with in treatment 7 with application of TA41 at 400 ml in 15 liter of water [full tank].

Number of grains/spike

Number of grains/spike was recorded significantly maximum (55.56) observed in treatment 7 with application of TA-41 at 400 ml in 15 liter of water [full tank]. However, treatment 4 with application of TA-41 at 10.0 liter in 200 liter of water in 1 hectare, treatment 5 with of application TA-41 at 200 ml in 15 liter of water [full tank] and in treatment 6 with application of TA-41 at 300 ml in 15 liter of water [full tank] were found to be statistically at par with in treatment 7 with application of TA-41 at 400 ml in 15 liter of water [full tank].

Grain yield

Significantly higher grain yield (6.88 t/ha) of wheat was found in treatment 7 with application of TA-41 at 400 ml in 15 liter of water [full tank], which was superior over all other treatments. The higher grain yield could be due to more dry matter accumulation in grain and no of grains per spikes because of application of plant growth regulator. Such finding was also supported by the Rahman *et al.* (2011).

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Straw yield

Significantly maximum straw yield (15.70 t/ha) was recorded in treatment 7 with application of TA-41 at 400 ml in 15 liter of water [full tank]. ~~Which~~ which was found superior over all other treatments as compared with other treatments.

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CONCLUSION

It is concluded that treatment T_7 with application of TA-41 at 400 ml in 15 ~~liter~~liters of water [full tank] was found to be the best that recorded highest plant dry weight, spikes/m^2, grains/spike, grain yield and straw yield. It also fetched the maximum gross return, net return and benefit: cost ratio. Since, the finding based on the research done in one season the experiment may be repeated to confirm the findings.

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COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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