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Morpho-physiological attributes of wheat (*Triticum aestivum* L.) as influenced by plant growth regulators and fertilizer application

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Abstract
In the present investigation, a field experiment with eight treatments and three replications of each treatment was conducted with Randomized Block Design (RBD) to explore effect of morpho-physiological traits of wheat crop (*Triticum aestivum* L.) as influenced by plant growth regulators and fertilizer application. Wheat plants were sprayed with growth regulators at 3-5 leaf stage and pre-anthesis stage. The treatments were subjected to 100% RDF, 75% RDF+25% Compost, 75% RDF+ 25% Vermicompost, Indole 3 Acetic Acid (IAA) 50 ppm and 75 ppm, Kinetin 10 ppm and 15 ppm. Result shows that foliar application of plant growth regulators and fertilizer application through broadcast helpful in improving plant growth traits such as plant height (cm), plant population per m2/plot, number of tillers per hill, number of productive tillers per hill, total dry matter (g), leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR). All the parameters were significantly influenced by plant growth regulators and no. of productive tiller/ hill significantly influenced by 75% RDF + 25% Vermicompost in respect to control.

Keywords: Wheat, plant growth regulators, fertilizer (RDF), morpho-physiological traits

Introduction
Wheat (*Triticum aestivum* L.) belongs to the genus *Triticum*, family: *Poaceae* (*Gramineae*). Wheat is second most important staple food crop, which physiologically categorized as a C3 plant. Among the wheat producing countries China rank 1st followed by India. In India, it is the second important stable food crop next to rice. Wheat and barely are considered the two main crops from grain crops, especially in the aired zones, that depend on rains in the cultivation. Wheat was used as food from last hundred years ago due to their long association with man's food. Therefore, it was cultivated in large scales in the world to cope the increasing need for food and food of the people (Gherroucha *et al*., 2011) [4]. Although plant growth regulators have been used in agriculture for as long as crop cultivation their impact up to now has been relatively little detected and their application is limited to some specific objectives for example quality and quantity improvement (Pandey *et al*., 2011) [10]. Plant growth regulators have been shown to influence plant growth, blooming, and assimilate transfer. (Hayat *et al*., 2001; Naeem *et al*., 2004) [7, 9]. The effect of various growth regulators on morphological characters like plant height, number of tillers, days to flower initiation indicated that these parameters differed significantly due to growth regulators. In the present study, therefore, an attempt was made to find out how for certain growth regulating substances with their various concentrations influence physiology of growth and metabolism of wheat crop. LAI are important morphological index of plant leaf which are closely connected with photosynthetic activity of leaves and control dry matter production therefore, present piece of work was carried out to ascertain the morpho-physiological traits responses of wheat cultivar to foliar applied plant growth regulators and fertilizer with their various concentrations.

Material and Methods
The field experiment was carried out at the Research cum Instructional Farm, Pandit S.K.S. College of Agriculture and Research Station, Surgi, Rajnandgaon, IGKV, Raipur, (CG) for the purpose to evaluate the effect of foliar application of plant growth regulators and fertilizer on morpho-physiological trait of wheat cultivar (Ratan). The treatment were: T1 – Control, T2 – 100% RDF T3 – 75% RDF + 25% Compost T4 – 75% RDF + 25% Vermicompost T5 - IAA 50 ppm T6 – IAA 75 ppm T7 – Kinetin 10 ppm T8 – Kinetin 15 ppm and each treatment

replicated three times. The desired quantity of each growth regulators *e.g*., IAA 50 mg and 75 mg and
Kinetin 10 mg and 15 mg were weighed on a chemical balance and dissolved in a few drops of alcohol and there after the alcoholic solution was added to 50 ml distilled water with constant stirring. This volume of solution was finally made up to one litre in volumetric flask. The solution was sprayed at 3-5 leaves stage, while second spraying was given at pre-anthesis stage.

Result and discussion

Plant height (cm): It has been concluded that Kinetin 15 ppm and 10 ppm and 100% RDF and 75% RDF + 25% vermicompost promoted that the plant height. While 75% RDF+25% compost and IAA 75 ppm and 50 ppm also enhanced the plant height but have lower rate in comparison to Kinetin. This increment in plant height is mainly due to stimulated the cell division and increased plasticity of cells. Similarly finding was also reported by Roitsch and Ehness (2000) [13] and Gogoi *et al.,* (2009) [5].

Number of tillers per hill: Number of tillers per hill increased with the advancement of the crop days in case of all growth regulators and fertilizer against control. More no. of tillers per hill is recorded in the foliar application of kinetin 15 ppm. It also had an uplifting effect on tiller number. It may be due to the increase in the availability, absorption, transport and growth stimulates by the wheat. Similar finding was reported by Rai *et al*., (2012) [12].

Number of productive tillers per hill: Number of productive tillers per hill significantly higher in 75% RDF + 25% Vermicompost. The results revealed that nitrogen had significant positive effect and was equally superior in terms of grains panicle-1, tillers hill-1. Similar, studied on the impact of different nitrogen levels on yield parameters character of Basmati rice cultivars *kharif* 2012 and 2013 by Sharma *et al.* (2014) [10].

Total dry matter (g): The total dry matter significantly varied among the treatments and the maximum total dry matter was found under Indole 3 Acetic Acid (IAA) 75ppm. The most important reason for higher dry weight at initial stage might be due to more assimilates production by the leaves. However, at harvesting stage, higher dry matter production is mainly due to higher assimilate translocation toward by sink. Similar trend also observed by hadole *et al*., (2002) [6], Asli *et al*., (2011) [2] and Aldesuquy *et al.*, (2001) [1].

Table 1: Influence of PGRs and fertilizer on plant height (cm), No. of tillers/hill, No. of productive tillers/hill and Total dry matter (g) of wheat (*Triticum aestivum* L.)

Treatment	Plant height(cm)	No. of tillers/hill	No. of productive tillers/hill	Total dry matter (g)	
				Flowering stage	Harvesting stage
Control	57.32	4.66	3.933	4.31	7.78
100% RDF	69.67	5.73	5.4	5.17	9.45
75% RDF+25% Compost	67.03	5.6	5.2	5.04	8.19
75%RDF+25% Vermicompost	68.66	6.33	6.033	5.05	9.10
IAA 50ppm	64.8	5.8	5.067	6.76	11.71
IAA 75 ppm	65.16	6.26	5.633	7.89	13.54
Kinetin 10 ppm	69.79	5.4	5.8	5.61	9.69
Kinetin 15 ppm	71.59	6.53	5.967	5.95	9.75
SEm ±	2.60	0.31	0.267	0.67	1.12
CD at 5%	6.75	9.35	8.609	20.30	19.72

Leaf area index (LAI): The leaf area index (LAI) is the most important parameter of growth analysis. It is a measure of canopy coverage per unit area and directly involved in photosynthesis. LAI of wheat crop was accelerated significantly against control after treatment of PGRs and fertilizers, maximum LAI Indole 3 Acetic Acid (IAA) 75ppm. It might be because PGRs have a favourable influence on cell division and elongation, resulting in increased leaf growth. Similar results also reported by Islam and Jahan (2016) in wheat crop.

Table 2: Influence of PGRs and fertilizer on Leaf area index (LAI) and Crop growth rate (CGR) of wheat (*Triticum aestivum* L.)

Treatment	LAI			CGR (g g-1 day-1)	
	30 DAS	45 DAS	60 DAS	Flowering stage	Harvesting stage
Control	2.44	6.76	12.64	0.035	0.054
100% RDF	3.01	9.2	13.28	0.046	0.058
75% RDF+25% Compost	2.65	8.59	14.33	0.044	0.068
75% RDF+25% Vermicompost	2.99	9.56	16.06	0.05	0.075
IAA 50 ppm	3.43	11.41	17.98	0.056	0.089
IAA 75 ppm	3.57	11.65	20.44	0.058	0.093
Kinetin 10 ppm	2.96	10.06	15.98	0.051	0.077
Kinetin 15 ppm	3.34	10.18	16.11	0.054	0.086
SEm ±	0.22	0.70	1.36	0.004	0.007
CD at 5%	12.88	12.58	14.91	14.88	17.83

Crop growth rate (CGR) and Relative growth rate (RGR): CGR and RGR were significantly affected by different treatments of PGRs (plant growth regulators) and fertilizer and observed maximum under IAA 75 ppm. The reduction in relative growth rate (RGR) and CGR was most likely caused by an increase in extracellular tissue, which contributed less to plant development. It has also been proposed that the drop in RGR might be related to higher leaves shadowing lower leaves. Similar finding were also reported Baruah. (1990) [3] and Thorne G. N. (1961) in barley.

Table 3: Influence of PGRs and fertilizer on Relative Growth Rate (RGR) and Net Assimilation Rate (NAR) of wheat (*Triticum aestivum* L.)

Treatment	RGR (mg g-1 day-1)		NAR (mg cm-2 day-1)	
	Flowering stage	Harvesting stage	Flowering stage	Harvesting stage
Control	7.39	4.23	0.97	0.24
100% RDF	9.21	5.33	1.52	0.34
75% RDF+25% Compost	8.84	5.92	1.26	0.32
75%RDF+25% Vermicompost	8.47	5.92	1.38	0.35
IAA 50ppm	12.33	8.91	1.88	0.43
IAA 75 ppm	11.52	8.84	1.60	0.41
Kinetin 10 ppm	11.31	7.20	2.08	0.50
Kinetin 15 ppm	10.74	6.06	1.80	0.42
SEm ±	1.00	0.78	0.17	0.043
CD at 5%	17.41	20.86	19.63	19.58

Net Assimilation Rate (NAR): Net assimilation rate represents plant photosynthetic efficiency. The net assimilation rate (NAR) was significantly differed and recorded maximum under Kinetin 10ppm. The decline in net assimilation rate during later stages of development might be ascribed to shadowing of lower leaves as well as a rise in the number of older leaves that lost photosynthetic rate. Similar finding were also reported Prajapati and Bharose (2020) [11].

Conclusion: According to above result of the experiment, it may be concluded that the foliar application of kinetin 15 ppm appreciates plant height (cm), NAR and number of tillers per hill. 75% RDF+25% Vermicompost accelerated the number of productive tillers per hill. LAI, CGR and RGR value was mainly improved by the application of Indole 3 Acetic Acid (IAA) 75 ppm.

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