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The response of different bio-regulators on growth and physiological traits of hybrid rice

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Abstract
Rice occupies a dominant position amongst the food grain produced in the country. Consumption pattern for rice varies in different parts of the country. Plant height at different stages varied considerably due to different growth regulators. Among the growth regulators, maximum plant height was obtained by the application of IAA-50 ppm followed by IAA 25 ppm, Whereas, Alar 100 ppm reduced the plant height. Increase in plant height was found by the application of IAA. The dry matter accumulation is probably due to increased chlorophyll synthesis, which has been increasing the rate of photosynthesis. Since, plants treated with Alar, TRIA, kinetin, IAA, had relatively higher chlorophyll Content at pre anthesis and post anthesis stages.

Keywords: food grain, IAA, growth, chlorophyll content etc.

Introduction
Rice (*Oryza sativa* L.) is the worlds, most important staple crop and primary source of food for more than half of the world's population. More than 90% of the world's rice is grown and consumed in Asia where about 60% of the earth's people live. Rice occupies a dominant position amongst the food grain produced in the country. Consumption pattern for rice varies in different parts of the country. In some areas, it is the staple food and in some places it is an important food item with other cereals. The area under during 2017-18 was 44.10 MH, with only about 43% of rice is under irrigated condition and a large area under this crop is under rainfed. During crop year 2017-18 total production of rice was recorded as high as 110.15 million tonnes with a productivity of 24.98 quintal per hectares (PIB. ministry of Agri. & Rural development). The quality rice is preferred over course grained rice. It is pre dominantly starchy food with the starch food ranging from 78-79% consisting of amylase and amylopectin fraction and offers a calorific value of 32-8 with digestibility coefficient of 76, biological value of 70 and protein efficiency ratio 2. Bio-regulators play a pivotal role in regulating the plant growth. Hormones play an important role inactivating or in activating the gene expressions both in plants and animals thus, the chemical growth regulators have now added a new dimension to the possibility of modifying plant growth development and metabolism. In principle, the availability of exogenous growth regulators to modify plant growth offers great opportunity. Again the high activity of hormones at low concentrations offers favorable cost consideration in their use.

Materials and Method
The field experiment was conducted at Students Instructions Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during Kharif 2017 in field no. 5. Kanpur is situated in subtropical region of about 25.3° to 28.5° North latitude and 79.3° and 80.3° west longitude. It is located in the alluvial belt at Ganegetic plains in the central part of Uttar Pradesh and its latitude from the see level is about 126 meter. It has a semi-arid climate with hot and desiccating summer having moderate rain fall and cold in winter receive rainy seasons from mid-June to September with a little shower in winter.
The experiment was laid out in randomized block design with three replications. The plot size (3.5 rows, 3 meter long) 3.5 x 3 m and the spacing was 22.5 cm x 10 cm (row x plant). The experimental field was properly leveled followed by preparatory irrigation afterward at optimum tilth, the field was ploughed and layout was done as per programme. Nitrogen, phosphorus and potash were applied in the form of urea, super phosphate and muriate of potash, respectively. Calculated dose of each fertilizer was applied to respective plot in the ratio of nitrogen 120 Kg/ha, phosphorus 60 Kg/ha and potash 50 Kg/ha, respectively. The foliar application of different treatments T1-control, T2 - IAA 25 ppm, T3 - IAA 50 ppm, T4 - Kinetin 5 ppm, T5 - kinetin 10 ppm, T6 - Triacontanol 1 ppm, T7-Triacontanol 2 ppm, T8 -

Alar 50 ppm and T9 - Alar 100ppm. Growth parameters viz. plant height, number of tillers hill-1 and dry biomass plant-1, Leaves / plant, Leaf area / plant, Dry matter production / plant 6. Relative growth rate (RGR), Days to flowering, Days to maturity and chlorophyll intensity. All the data on growth metabolism, yield and yield contributory characters were statistically analyzed by the method suggested by Fisher (1937) [13].

Result and Discussion

Plant height: It is evident from the table 1 that plant height was considerably influenced by hormonal treatment during the year, caused significant increase over control in this respect, the maximum increase in plant height was obtained by the plants under IAA 50 ppm which was significantly superior to its lower one, in different stages tillers heading, dough and maturity. On the other hand, plant height was significantly reduced with higher castration of Alar 100 ppm respectively. These during early stages of tillering continued to successive stages of growth viz, tillering, headings dough and maturity.

Table 1: Effect of bio-regulators on plant height (cm) per plant at different stages of growth.

Treatment	Tillers	Heading	Dough	Maturity
T_1 control	18.34	37.33	49.33	57.99
T_2 IAA25 ppm	21.67	41.66	53.33	64.22
T_3 IAA 50 ppm	23.00	42.33	54.95	66.12
T_4 Kinetin 5 ppm	20.00	41.00	52.19	59.88
T_5 kinetin 10 ppm	19.50	40.25	51.25	58.44
T_6Triacontanol 1 ppm	20.78	40.66	53.00	62.88
T_7Triacontanol 2ppm	20.12	40.00	52.00	59.99
T_8 Alar 50ppm	17.67	36.25	47.33	57.25
T_9 Alar 100 ppm	17.12	34.65	46.12	56.00
CD at 5%	0.369	0.475	0.978	0.686
SE±(d)	0.790	1.015	2.092	1.467

Number of tillers per plant: It revealed from the result (Table-2) that different bio-regulators influenced the tillers production, the Maximum number of tillers were observed under the higher concentration of IAA 50 ppm closely followed by, IAA 25 ppm, Triacontanol 1 ppm Kinetin 5 ppm and Alar 100 ppm at different stages of growth and both were significantly superior to control, whereas, minimum number of tiller per plant was recorded under the treatment of kinetin 10 ppm at tillering stages of growth during the year of the experimentation. Tiller production continued to increase slightly from the tillering to dough stage in all the treatment with the same trend of response as described above. At maturity stage its numbers were slightly declined.

Table 2: Effect of bio-regulators on tillers per plant at different stages of growth.

Treatment	Tillers	Heading	Dough	Maturity
T_1 control	4.15	7.34	8.66	9.657
T_2 IAA25 ppm	5.86	9.87	11.66	12.66
T_3 IAA 50 ppm	6.13	11.25	12.88	13.76
T_4 Kinetin 5 ppm	5.20	8.84	10.00	11.66
T_5 kinetin 10 ppm	5.0	8.00	9.50	10.98
T_6 Triacontanol 1 ppm	5.66	9.34	11.65	11.97
T_7 Triacontanol 2 ppm	5.33	8.88	10.68	11.10
T_8 Alar 50ppm	4.36	7.67	8.66	10.22
T_9 Alar 100 ppm	4.67	8.00	9.34	10.88
CD at 5 %	0.228	0.235	0.384	0.302
SE±(d)	0.488	0.501	0.822	0.646

Numbers of leaves per plant significantly increase against control among the treatment, more number of leaves per plant was found with the treatment of IAA 50 ppm treated plant at different stages of growth. The finding confirmed the view reported earlier by Pinto *et al*., (2005). The number of leaves per plant at successive stage of growth have been presented in Table-6, which obviously revealed, that different bio regulator treatment have profound effect on this character. Thus, during early stage of plant growth, leaf production by plants followed the same trend which was in tiller production and this effect was carried over at successive stages of growth. Higher concentration of IAA proved to be most effective in this regard and produce significantly more number of leaves than all other treatment at all the stages of growth, where as minimum number of leaves were recorded under treatment of alar 50 ppm and kinetin10 ppm. At the maturity stage, the response of bio-regulators on number of leaves per plant have also seen.

Table 3: Effect of bio-regulators on number of leaves per plant at different stages of growth.

Treatment	Tillers	Heading	Dough
T_1 control	15.15	28.50	35.66
T_2 IAA25 ppm	18.50	35.88	43.54
T_3 IAA 50 ppm	20.25	37.99	45.66
T_4 Kinetin 5 ppm	17.50	32.85	39.66
T_5 kinetin 10 ppm	16.25	30.33	38.25
T_6 Triacontanol 1 ppm	18.25	34.33	41.66
T_7 Triacontanol 2ppm	17.95	33.66	40.25
T_8 Alar 50ppm	15.50	29.87	37.25
T_9 Alar 100 ppm	15.98	30.00	38.00
CD at 5%	0.684	0.521	0.608
SE±(d)	1.463	1.115	1.301

Growth Stages

The significance of leaf area increments in higher grain production have been discussed and emphasized from time to time where the higher leaf area index was found to be positively correlated with higher grain yield. In the discussions, it can be said that higher leaf area implies more because the sink source relationship increase with increase in photosynthates and hence is reflected to grains hence more grain yield recorded. In IAA maximum leaf area per plant was found These findings are confirm with the findings of Aldesuquy (2000) [4], IAA stimulated flag leaf growth by application 0,5,25, or 50 mg 1AA/kg prior to sowing (seed soaked).

Table 4: Effect of bio-regulators on leaf area at different stages of growth (cm)

Treatment	Tillers	Heading	Dough
T_1 control	216.62	955.08	1352.14
T_2 IAA25 ppm	367.96	1594.74	2143.04
T_3 IAA 50 ppm	426.38	1750.51	2505.46
T_4 Kinetin 5 ppm	339.93	1260.27	1827.47
T_5 kinetin 10 ppm	264.46	1091.88	1653.74
T_6 Triacontanol 1 ppm	338.76	1549.99	2075.44
T_7 Triacontanol 2 ppm	309.85	1447.78	1852.44
T_8 Alar 50ppm	259.91	1110.97	1522.58
T_9 Alar 100 ppm	241.20	1106.96	1600.78
SE±(d)	22.59	16.895	12.95
CD at 5%	48.301	36.124	27.702

Growth Stages

The dry matter accumulation is probably due to increased chlorophyll synthesis, which has been increasing the rate of

photosynthesis. Since, plants treated with Alar, TRIA, kinetin, IAA, had relatively higher chlorophyll Content at pre anthesis and post anthesis stages.

Total dry matter production

The result related to total dry matter production showed that treated plants produced significantly higher plant dry matter as against the control. On overall basis, application of IAA 50ppm helped maximum increase in dry matter production at all the stages. Whereas, alar 50 ppm response at maturity was poor reprise during the year of experimentation. At tillering stage, all the treatment significantly increased the dry matter production of whole plant. Application of IAA 50 ppm resulted maximum dry matter production as compared to control. It was followed by triacontanol 1ppm and kinetin 5 ppm. Alar 50ppm also showed better improvement in dry matter production of whole plant in comparison to control. At heading stage, dry matter production of whole plant obviously showed significant variation due to bio-regulators treatment.

The effect of IAA was more pronounced in comparison to other plant growth regulators, it was followed by triacontanol 1 ppm, kinetin 5 ppm and alar 100ppm at dough and maturity stages. All the plant growth regulators once again followed previous trend as those observed at tillering and heading stages the highest increase was recorded with IAA 50 ppm.

Days of maturity

Observation recorded with respect to time of peak maturity of paddy variety following growth regulators treatment have been presented in table-I1. It was noted that IAA 50 ppm delayed maturity 9 days in plants as compared to control. Whereas, kinetin 10 ppm caused early maturity during the year of experimentation.

Relative growth rate (RGR)

All bio-regulators considerably influenced the Relative growth rate value per plant at all stages of growth, (Table-5). The maximum RGR value was recorded under the treatment of kinetin 10 ppm between tillering and heading stage. However between heading and dough stage, kinetin 10 ppm proved superior to rest of the treatment. The relative growth rate varies with the advancement of stage.

Table 5: Effect of bio regulation on total dry matter production.

Dry matter at different Growth stages (g)				
Treatment	**Tillers**	**Heading**	**Dough**	**Maturity**
T_1 control	4.20	17.15	30.15	57.50
T_2 IAA25 ppm	6.33	22.35	35.26	64.90
T_3 IAA 50 ppm	7.12	24.56	37.50	66.51
T_4 Kinetin 5 ppm	5.88	20.10	34.25	60.55
T_5 kinetin 10 ppm	5.66	19.45	33.20	60.40
T_6 Triacontanol 1 ppm	6.15	21.46	35.65	62.88
T_7 Triacontanol 2 ppm	6.02	20.36	34.10	61.70
T_8 Alar 50ppm	4.25	18.20	34.55	59.89
T_9 Alar 100 ppm	4.58	18.90	35.20	60.17
SE±(d)	0.309	0.342	0.240	0.078
CD at 5%	0.662	0.731	.514	0.116

Table 6: Effect of bio regulators on chlorophyll percent

Treatment	Pre anthesis	Post anthesis
T_1 control	34.66	29.63
T_2 IAA25 ppm	39.40	32.20
T_3 IAA 50 ppm	41.04	34.60
T_4 Kinetin 5 ppm	35.80	31.30
T_5 kinetin 10 ppm	35.65	30.60
T_6 Triacontanol 1 ppm	38.66	31.80
T_7 Triacontanol 2ppm	39.00	31.61
T_8 Alar 50ppm	38.30	32.80
T_9 Alar 100 ppm	37.24	31.6

Table 7: Effect of bio regulators on flowering and maturity

Treatment	Flowering (days)	Maturity (days)
T_1 control	63.98	110.66
T_2 IAA25 ppm	69.66	116.66
T_3 IAA 50 ppm	70.64	118.35
T_4 Kinetin 5 ppm	63.00	115.66
T_5 kinetin 10 ppm	62.99	115.00
T_6 Triacontanol 1 ppm	69.66	116.33
T_7 Triacontanol 2ppm	68.33	116.00
T_8 Alar 50ppm	67.96	114.00
T_9 Alar 100 ppm	68.50	114.66
SE±(d)	0.618	0.658
CD at 5%	1.322	1.408

Table 8: Effect of bio-regulators on relative growth rate between different growth stages (mg/g /day)

Treatment	Between Tillering & heading	Between Heading and dough	Between Dough and maturity
T_1 control	48.70	20.00	25.67
T_2 IAA25 ppm	50.40	18.21	24.41
T_3 IAA 50 ppm	49.60	16.97	22.80
T_4 Kinetin 5 ppm	49.20	21.34	22.93
T_5 kinetin 10 ppm	49.20	21.70	24.00
T_6 Triacontanol 1ppm	50.00	20.40	22.84
T_7 Triacontanol 2ppm	48.80	20.77	23.69
T_8 Alar 50ppm	58.80	25.60	22.10
T_9 Alar 100 ppm	57.200	25.84	21.48
SE±(d)	0.586	0.351	0.379
CD at 5%	1.252	0.751	0.809

Conclusion

Foliar spray of all growth regulators in both the concentration help in greater accumulation of food material in different plant organs and increased the dry matter content of stem, leaf panicle and the whole plant. Thus, the plant dry weight was found significantly more under treated plants at different stages of growth. Maximum plant dry weight per plant was measured under the treatment of IAA 50 ppm closely followed by triacontanol 1 ppm, whereas, minimum dry weight was recorded under control.

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