

Original Research Article

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Impact of Plant Growth Regulators on Growth, Phenology and yield Characters of Hybrid Rice

Pawan Kumar Goutam^{1*}, S.P. Kushwaha¹, Dharmadew Chauhan²,
Vikas Yadav¹ and Subhash Kumar¹

¹Department of Crop Physiology, ²Department of Biochemistry, College of Agriculture, C.S. Azad University of Agriculture & Technology, Kanpur -208 002, India

*Corresponding author

ABSTRACT

Keywords

Foliar application, GA₃, IAA, NAA, Triacontanol (TRIA), Cycocel, Growth parameters, Phenology, Nitrogen content in straw (%), Yield, Hybrid rice

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The influence of foliar applied plant growth regulators on rice crop was conducted on hybrid rice crop during *kharif* season's 2015 and 2016. Application of five growth regulators each in two concentration *viz.*, GA₃ 20 and 40 ppm, IAA 25 and 50 ppm, NAA 10 and 20 ppm, Triacontanol 5 and 10 ppm, Cycocel 3000 and 4000 ppm and one unsprayed control with foliar sprays at tillering and flowering stages for growth, yield parameters. The observation was recorded at different stages of crop. Higher concentration of IAA produce maximum dry biomass, increased the total leaf area plant⁻¹, total number of leaves at different crop growth stages, CCC delayed flowering and maturity, IAA produced higher nitrogen content in straw (%) and grain yield plant⁻¹ (g) over control (T₁).

Introduction

Rice is one of the staples food crop in India and most of country, its food provide energy, carbohydrate, proteins, vitamins consumed by majority of the population. World rice production 490.8 million metric tonnes and India rice production 109.7 million metric tonnes in year 2016-17 (USDA 2018). In India rice play key role it contributes also 46% of

Indian cereal production and also staple food for two third of the population. India has 433.88 lakh hectares in area and production 104.32 million tones in year 2015- 16 (DAC& FW 2016-17). National Food Security Mission target of 3 million hectares, area under hybrid rice continue to range from 1.8 to 2.0 million hectares in the last few years. Hybrid rice plays a most important role for increase is yield in unit area. The yield advantage of 15-

20% over the best pure line varieties (6.5 t ha^{-1} as against 5.4 t ha^{-1}) proved the key factor for wide adoption of the hybrid rice technology. Plant growth regulators play an essential role in regulating plant growth and development. Growth regulator is only needed in small amounts to determine the course of physiological processes, growth, differentiation, and development (Davies, 1995).

Materials and Methods

Research experiment on impact of foliar applied plant growth regulators on growth parameters and yield of hybrid rice (PHB-71) was conducted during *Kharif* season 2015 and 2016, in Randomized Block Design with three replications at Student Instructional Farm at C.S. Azad University of Agriculture and Technology Kanpur, The experiment carried out with foliar application of five growth regulators each in two concentration, total eleven treatment as GA₃ 20 and 40 ppm, IAA 25 and 50 ppm, NAA 10 and 20 ppm, Triacantanol 5 and 10 ppm, Cycocel 3000 and 4000 ppm and control which were replicated three times, two foliar spray was done at tillering and at flowering time with sprayer. Nitrogen content in rice leaves was estimated by using instrument, semi- auto nitrogen analyzer of model KEL PLUSH. These instrument works on the principal of kjeldahl method of nitrogen analysis. Different observations were recorded as Total dry biomass of plant (g), Total leaf area plant⁻¹, Total number of leaves plant⁻¹, at different stages. Days to 50 % flowering, days to maturity, nitrogen content in straw (%), Grain yield plant⁻¹ (g).

Results and Discussion

The dry matter production is mainly due to higher translocation efficiency of assimilates source to sink, in pooled analysis over two

year (Table 1) result indicated that maximum total dry biomass was recorded with the IAA 50 ppm followed by TRIA 5 ppm and others treatment of PGRs also give better response at 30, 60, 90 DAT and at maturity stages of crop in both the years 2015 and 2016. These findings are in conformity to Aldesuquy H.S. (2001), Prajapati *et al.*, (2017). Who obtained similar improvement in dry matter production by leaves and stem by the use of IAA and TRIA.

A morphological and important yield supporting character *i.e.* total leaf area plant⁻¹ showed in (Table 2) that the pooled analysis over two year data maximum found with IAA 50 followed by TRIA 5 ppm. Others plant growth regulators also enhance the total leaf area plant⁻¹ in comparison to control in both the years 2015 and 2016. Finding was supported by Panday *et al.*, (2001), Sutedja (1993).

In pooled analysis over two year data (Table 3) showed that total numbers of leaves was highly produced with the treatment of IAA 50 ppm as compare to TRIA 5 ppm in different growth stages. Other growth hormones are also increases total number of leaves in rice crop in both years 2015 and 2016. Finding supported by Tripathi (1978), Prajapati *et al.*, (2017).

Days to flowering and maturity pooled analysis over two year data (Table 4) indicated that CCC 3000 and 4000 ppm give late flowering and maturity of the crop in both the year 2015 and 2016 strongly supported by Mehrotra *et al.*, (1983), Dighe *et al.*, (1985), Sexana *et al.*, (1988). IAA and other treatment also delayed flowering and maturity with the observation of Pandit *et al.*, (1986), Rajendra and Jones Jonathan (2009). Treatment of GA₃ caused early flowering supported by Naeem *et al.*, (2004), Awan *et al.*, (1999) and Ilium Lee *et al.*, (1999) in both the year in rice crop.

In pooled analysis over two year data showed that the maximum nitrogen content in straw at maturity stage showed (Table 4) was mainly affected by the foliar spray of IAA 50 ppm followed by lower dose of IAA 25 ppm. Other hormones in different concentrations also accelerating the nitrogen value in straw. This result is favor by the discussion given by Patil *et al.*, (1989), Prajapati *et al.*, (2017).

Plant hormones increased the grain yield plant⁻¹ (g) in pooled analysis over two year data (Table 4) indicate the highly produced by the foliar spray of IAA 50 ppm followed by TRIA 5 ppm, others treatments in different concentration also effective in producing grain yield plant⁻¹. This conclusion was favored by Hussien (2011), Borowaski *et al.*, (2000), Choi *et al.*, (2010).

Table.1 Impact of various growth regulators on Total dry biomass of Hybrid Rice at different crop growth Stages

Treatments	Total dry biomass (g)											
	30 DAT			60 DAT			90 DAT			Maturity		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T₁- Control	3.10	3.38	3.24	10.50	11.07	10.79	23.40	23.87	23.64	36.26	36.70	36.48
T₂- GA₃ 20 ppm	3.88	4.31	4.10	14.48	15.03	14.76	29.30	29.76	29.53	52.10	52.59	52.35
T₃- GA₃ 40 ppm	4.15	4.54	4.35	15.60	16.12	15.86	30.27	30.79	30.53	54.78	55.13	54.96
T₄- IAA 25 ppm	4.12	4.53	4.33	14.70	15.25	14.98	31.40	31.95	31.68	56.55	56.91	56.73
T₅- IAA 50 ppm	4.56	5.01	4.79	16.41	16.92	16.67	33.10	33.61	33.36	61.70	62.06	61.88
T₆- TRIA 5 ppm	4.40	4.72	4.56	15.60	16.15	15.88	31.80	32.30	32.05	59.00	59.36	59.18
T₇- TRIA 10 ppm	4.00	4.28	4.14	14.80	15.33	15.07	27.93	28.57	28.25	53.34	53.80	53.57
T₈- NAA 10 ppm	3.75	4.15	3.95	14.30	14.83	14.57	28.30	28.79	28.55	49.46	49.91	49.69
T₉-NAA 20 ppm	4.03	4.40	4.22	14.87	15.40	15.14	29.20	29.70	29.45	50.90	51.36	51.13
T₁₀- CCC 3000 ppm	3.60	3.99	3.80	13.47	14.03	13.75	29.15	29.64	29.40	47.20	47.55	47.38
T₁₁-CCC 4000 ppm	3.35	3.75	3.55	12.28	12.82	12.55	26.62	27.14	26.88	43.70	44.18	43.94
SE(d)	0.15	0.16	0.11	0.74	0.95	0.59	0.56	0.77	0.47	1.02	1.09	0.75
CD at 5%	0.33	0.34	0.22	1.54	2.00	1.19	1.17	1.60	0.96	2.13	2.27	1.50

Table.2 Impact of various growth regulators on Total leaf area plant⁻¹ of Hybrid Rice at different growth Stages

Treatments	Total leaf area plant ⁻¹											
	30 DAT			60 DAT			90 DAT			Maturity		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T₁- Control	178.20	187.48	182.84	786.55	909.45	848.00	1228.50	1397.65	1313.08	1058.40	1218.75	1138.58
T₂- GA₃ 20 ppm	264.69	332.58	298.64	1250.43	1405.53	1327.98	1853.77	2097.90	1975.84	1607.09	1865.43	1736.26
T₃- GA₃ 40 ppm	334.42	411.48	372.95	1477.98	1645.99	1561.99	2173.50	2394.00	2283.75	1888.11	2109.93	1999.02
T₄- IAA 25 ppm	359.10	446.22	402.66	1593.64	1771.71	1682.68	2303.32	2534.64	2418.98	2046.87	2287.01	2166.94
T₅- IAA 50 ppm	461.60	552.82	507.21	1846.68	2046.60	1946.64	2692.80	2877.67	2785.24	2409.41	2649.60	2529.51
T₆- TRIA 5 ppm	375.87	458.28	417.08	1713.15	1905.98	1809.57	2412.48	2623.56	2518.02	2165.62	2392.32	2278.97
T₇- TRIA 10 ppm	285.07	359.66	322.37	1521.45	1697.28	1609.37	2147.06	2362.08	2254.57	1927.80	2122.31	2025.06
T₈- NAA 10 ppm	252.45	314.21	283.33	1111.01	1252.02	1181.52	1643.98	1813.50	1728.74	1510.86	1669.50	1590.18
T₉-NAA 20 ppm	285.44	352.56	319.00	1085.04	1232.01	1158.53	1586.91	1780.80	1683.86	1450.08	1635.30	1542.69
T₁₀- CCC 3000 ppm	303.52	368.25	335.89	1183.26	1328.29	1255.78	1723.57	1912.50	1818.04	1521.00	1702.99	1612.00
T₁₁-CCC 4000 ppm	236.92	294.08	265.50	1022.40	1162.07	1092.24	1511.64	1576.57	1544.11	1319.76	1497.60	1408.68
SE(d)	12.17	13.08	8.93	99.11	162.15	95.01	62.94	97.33	56.70	158.73	153.50	100.18
CD at 5%	25.41	27.30	18.06	206.82	338.36	192.03	131.34	203.12	114.45	284.06	320.33	202.22

Table.3 Impact of various growth regulators on total number of leaves of hybrid rice at different growth Stages

Treatments	Total number of Leaves											
	30 DAT			60 DAT			90 DAT			Maturity		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T₁- Control	14.85	15.15	15.00	27.70	28.50	28.10	30.20	31.10	30.65	29.00	28.00	28.50
T₂- GA₃ 20 ppm	17.30	18.10	17.70	33.50	33.10	33.30	37.10	38.30	37.70	36.10	37.90	37.00
T₃- GA₃ 40 ppm	18.20	19.05	18.63	35.60	36.13	35.87	39.50	40.00	39.75	38.30	39.10	38.70
T₄- IAA 25 ppm	19.00	20.10	19.55	36.62	37.14	36.88	40.30	40.80	40.55	39.20	40.05	39.63
T₅- IAA 50 ppm	20.25	21.00	20.63	38.50	39.11	38.81	42.40	42.00	42.20	41.30	41.80	41.55
T₆- TRIA 5 ppm	19.35	20.10	19.73	37.40	38.09	37.75	40.90	41.10	41.00	40.00	40.60	40.30
T₇- TRIA 10 ppm	18.10	19.03	18.57	36.50	37.10	36.80	39.70	40.15	39.93	39.00	39.30	39.15
T₈- NAA 10 ppm	16.50	17.10	16.80	31.50	32.10	31.80	35.70	36.00	35.85	34.80	35.00	34.90
T₉-NAA 20 ppm	17.62	18.15	17.89	32.40	33.08	32.74	36.30	37.00	36.65	35.40	36.06	35.73
T₁₀- CCC 3000 ppm	18.65	19.18	18.92	34.60	35.12	34.86	38.50	39.00	38.75	37.50	38.10	37.80
T₁₁-CCC 4000 ppm	17.55	18.07	17.81	33.40	34.07	33.74	37.30	38.00	37.65	36.20	37.00	36.60
SE(d)	1.05	1.20	0.78	1.60	1.84	1.19	1.35	1.63	1.04	1.32	1.42	0.95
CD at 5%	2.19	2.51	1.57	3.35	3.85	2.41	2.89	3.41	2.11	2.76	2.97	1.92

Table.4 Impact of various growth regulators on 50 % flowering and maturity, Nitrogen content in straw (%) and, grain yield plant⁻¹ (g) of Hybrid Rice

Treatments	Days to 50% flowering			Days to maturity			Nitrogen content in straw (%)			Grain yield plant ⁻¹ (g)		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T₁- Control	84.00	85.00	84.00	130.00	131.00	130.50	0.52	0.53	0.53	20.10	20.15	20.13
T₂- GA₃ 20 ppm	84.88	85.11	84.88	131.33	131.44	131.39	0.58	0.59	0.59	21.45	21.50	21.48
T₃- GA₃ 40 ppm	84.99	86.00	84.99	131.77	131.88	131.83	0.59	0.60	0.60	22.65	22.70	22.68
T₄- IAA 25 ppm	86.11	86.44	86.11	134.88	135.00	134.94	0.61	0.62	0.62	22.85	22.95	22.90
T₅- IAA 50 ppm	86.22	86.55	86.22	135.00	135.22	135.11	0.62	0.63	0.63	25.20	25.30	25.25
T₆- TRIA 5 ppm	87.33	87.77	87.33	133.66	133.77	133.72	0.60	0.61	0.61	24.26	24.30	24.28
T₇- TRIA 10 ppm	87.11	87.33	87.11	133.44	133.66	133.55	0.59	0.60	0.60	23.00	23.10	23.05
T₈- NAA 10 ppm	85.44	85.66	85.44	132.22	132.44	132.33	0.56	0.57	0.57	22.85	22.90	22.88
T₉-NAA 20 ppm	85.66	85.88	85.66	132.44	132.66	132.55	0.57	0.58	0.58	21.70	21.80	21.75
T₁₀- CCC 3000 ppm	87.44	87.99	87.44	135.11	135.33	135.22	0.56	0.57	0.57	22.60	22.65	22.63
T₁₁-CCC 4000 ppm	87.66	88.22	87.66	135.22	135.55	135.39	0.55	0.56	0.56	21.44	21.52	21.48
SE(d)	0.88	0.87	0.60	1.06	1.39	0.86	0.011	0.014	0.009	1.02	1.04	0.71
CD at 5%	1.84	1.82	1.22	2.21	2.91	1.73	0.025	0.030	0.019	2.14	2.18	1.44

In conclusion foliar application of plant growth regulators (PGRs) mainly IAA was very effective for increasing dry biomass, total leaf area plant⁻¹, total number of leaves, days to 50 % flowering and maturity, nitrogen content in straw (%), grain yield plant⁻¹ (g) during both *kharif* years 2015 and 2016. The treatments of hormones most effective for physiological, morphological and yield parameters in hybrid rice crop.

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