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Original Research Article

Effect of Foliar Application of PGRs on Growth and Biochemical Changes of Rice (*Oryza sativa* L.) under Salt Stress Condition

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Keywords

PGRs, growth and biochemical changes

A B S T R A C T

The present investigation entitled "Effect of foliar application of PGRs on growth and biochemical changes of rice (*Oryza sativa* L.) under salt stress condition'' was conducted during the *kharif* season in 2016 at the MES Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad. The experiment was setup in randomized block design (Factorial) with three replications and seven treatments on rice varieties CSR-36 and CSR-43 under salt stress condition. The GA_3 (100, 150 and 200ppm) and salicylic acid (100, 150 and 200ppm) were applied as foliar application at 15 DAT. Growth, yield and yield attributes were taken after crop harvest. All PGRs showed superior value in all the stages of crop with respect to control. Growth parameters viz. plant height, number of tillers $hill^{-1}$ and dry biomass $plant^{-1}$ and Bio-chemical parameters viz. Chlorophyll content, Relative water content,, catalase and peroxidase, sodium, Phenology of crops were also observed were found superior with foliar application of GA_3 200ppm followed by SA 200ppm. Rice variety CSR-43 performed better than CSR-36 in all respects.

Introduction

The most important stable food crop in the world.More than 90% of the world's rice is grown and consume Asia where 60% of the earth's people and about two-thirds of the world's poor live (Khush and Virk, 2000). In Asia more than 2 billion people are getting 60-70% of their energy requirement from rice, demand for rice is growing every year and it is estimated that in 2010 and 2025 AD the requirement was be 100 and would be 140 million tons, respectively. To sustain present food self-sufficiency and to meet future food requirement, India has to increase its rice productivity by 3% per annum (Thiyagarjan and selvaraju, 2001). Rice being climatically the most adopted cereal. It is grown over a large spatial domain and wide range of landscape type. A large number of unique paddy farming methods have also evolved, based on farming type (irrigated, rain fed, deep-water). Depending upon location Indian rice is grown in the *kharif* (summer, wet) or *Rabi* (winter, Dry) season both. Salt stress is one of the global problem rendering vast areas non suitable for cultivation. About 95

million ha earth surface is affected due to salt problem (Ghassemi, 1995). In Asia alone, 21.5 million ha area is affected of which 12.0 million ha are saline and 9.5 million ha are Alkaline. The salt affected soil are spread over 8.4 million ha (4% of the total cultivated area) in India and account for a loss of about us 300 million per dollars (singh *et al.,* 2003) Gibberellin (GA_3) control different developmental processes in plants (Pospíšilová, 2003). GA3 are responsible for expansion and cell division in shoot elongation, flowering and seed germination. All phyto-hormones exert their regulatory role in close relation with each other.

Hormone signaling pathways form complex interacting network, which enables perceiving of numerous internal and external stimuli and generating respective plant responses. Additionally, exogenously applied growth regulators can alter the content of endogenous phyto-hormones.

The biosynthesis of GA_3 is regulated by both developmental and environmental (Yamaguchi & Kamiya, 2000). Salicylic acid is ortho-hydroxybenzoic acid and is a secondary metabolic acting as analogous of growth regulating substances. It helps in protection of nucleic acid and prevention of protein degradation.

The salicylic acid is also known to induce many genes coding for parthenogenesis and proteins in response to biotic and abiotic stresses (Enyedi, *et al.,* 1992, Yalpani, *et al.,* (1994). Foliar application of salicylic acid increased the IAA content in board bean leaves (Xin, *et al.,* 2000). Foliar application of salicylic acid exerted a significant effect on plant growth metabolism when applied at physiological concentration, and thus acted as one of the plant growth regulating substance (Kalarani, *et al., 2002).*

Materials and Methods

The Main Experiment Station (MES) of the Narendra Deva University of Agriculture and Technology, (Narendra Nagar) Kumarganj, Faizabad (U.P.) "Effect of foliar application of PGRs on growth and biochemical changes of rice (*Oryza sativa* L.) under salt stress condition'' In the present study, Variety CSR-36 and CSR-43 under salt stress condition was taken as experimental materials to find out the response of PGRs on growth and yield contributing traits of rice in RBD with three replications and seven treatments and variety CSR-36 and CSR-43.Various foliar application of GA_3 (100, 150 and 200ppm) and salicylic acid (100, 150 and 200ppm) were applied as foliar application at 15 DAT. Growth parameters viz. plant height, number of tillers $hill^{-1}$ and dry biomass $plant^{-1}$ and Bio-chemical parameters viz. Chlorophyll content, Relative water content,, catalase and peroxidase, sodium, Phenology of crops were also observed were found superior with foliar application of GA_3 followed by Rice variety CSR-43 performed better than CSR-36 in all respects.

Results and Discussion

Plant height

The data with respect to plant height presented in table 4.1.1and fig. 1 Perusal of data revealed that the maximum plant height (74.40 cm) was recorded with sprayed of GA_3 200 ppm, which found significantly superior over other treatments including control (36.52 cm). Almost similar pattern were followed at other stages of plant growth except at harvest stage, where non-significant variation was observed. As for as varieties were concerned the variety CSR-36(54.17 cm) showed significantly higher

plant height as compare to CSR-43(50.95 cm).similar pattern was noted in succeeding growth stages of the plant. It may be because of genetically characters of the variety coupled with foliar sprayed of PGRs. Similar finding are agreement with Abd *et al.,* (1997**)** Deka and DAS (1975), Shibario *et al.,* (2001), Afshari *et al.,* (2013)

Number of tillers Plant^{-1}

Observation with respect to number of tillers plant^{-1} presenting in table 4.1.2 and fig. 2. It is evident from the data that significant variations were observed due to main effect at different stages of plant growth. However, the maximum number of tillers hill^{-1}(7.61) was counted in variety CSR-43 as compare to CSR-36(7.31) at 30 DAT. Similar pattern was observed at other growth stages of plant including harvest stage. The foliar application of GA_3 200 ppm showed highest number of tillers plant^{-1} (8.16 tillers plant^{-1}) over other treatments including control (6.33 tillers plant^{-1}) at 30 DAT. Similar pattern were followed in succeeding stages of plant growth. These result are accordance with that of Elanhavi *et al.,* (2009), Nitumoni *et al.,* (2000**)** Kalavathi *et al.,* (2000**)** and Yogesha *et al.,* (2000)

Dry biomass hill^{-1} (g)

Data with respect to plant dry biomass plant^{-1} presenting in table 4.1.3 and fig. 3. It is apparent from the data that significantly higher plant dry biomass hill^{-1} (2.97 g) was recorded in variety CSR-43 than CSR-36 (2.82), at 30 DAT. Similar pattern was followed in other stages of plant growth except the harvest stage, which showed non-significant variation. As far as different treatments were concerned GA_3 200 ppm showed significantly higher dry biomass hill^{-1}(3.32 g) as compare to other treatments including control (2.56 g) at 30 DAT. Similar pattern was noted in succeeding growth stages. These result are accordance with that of Reddy *et al.,* (2004) and Khan *et al.,* (1998), Jeyakumar *et al.,* (2008) reported that application of salicylic acid (125 ppm increased the dry matter production (21.6 g/plant) in black gram.

Chlorophyll content

The significantly higher chlorophyll content was observed with foliar application of GA_3 200 ppm at 30, 60, 90 DAT, respectively followed by salicylic acid 200 ppm with respect to control. Chlorophyll content was noted higher in CSR-43 as compare to CSR-36.

These result are accordance with that of Shairy and Hegazi (2009), conducted pot experiment to investigation the effect of acetyl salicylic acid (10 and 20 ppm) IBA (50 and 100 ppm) and GA_3 (50 and 100 ppm) applied as foliar application at different growth stages on pea significantly increase total chlorophyll content leave. These results are conformity with the Senthil *et al.,* (2003) and Khan *et al.,* (2003).

Relative water content (%)

All the foliar sprayed of PGRs increase the relative water content in rice plants. Higher relative water content was observed with foliar sprayed of GA_3 200 ppm at 30 and 60 DAT, while at 90 DAT it was found non-significant variations. Minimum relative water content was observed with control, this increased was might be due to increase the osmotic presser of cytoplasm by synthesis of more prolineosmolytes as compare to control which ultimately help in observing water adverse in conditions. The result corroborated with finding of Kdioglu *et al.,* (2011) and Yildrin *et al.,* (2008). He *et al.,* (2005)

Table.1 Effect of foliar application of PGRs on growth and biochemical changes of rice var. CSR-36 and CSR-43

Lvael of PGRs (ppm)	Plant Height (cm)		Number of tillers Plant^{-1}		Dry biomass hill^{-1} (g)		Chlorophyll content		RWC		Catalase activity		Peroxidase activity		Sodium content		50% flowering	
	CSR36	**CSR43**	**CSR36**	**CSR43**	**CSR36**	**CSR43**	**CSR36**	**CSR36**	**CSR36**	**CSR43**	**CSR36**	**CSR43**	**CSR36**	**CSR43**	**CSR36**	**CSR43**	**CSR36**	**CSR43**
Control	95.3	93.41	981	10.01	24.82	26.03	10.56	12.36	71.29	71.43	445.21	477.28	361.62	372.21	26.29	25.06	97.24	100.24
GA_3(100ppm)	104.19	100.05	10.87	10.87	26.11	27.80	12.90	13.34	80.425	80.47	485.56	493.85	385.25	381.62	25.15	24.25	100.25	103.67
GA_3(150ppm)	112.21	103.67	11.97	11.73	27.56	29.64	13.25	13.85	81.38	81.74	478.84	498.29	412.63	419.51	24.86	23.41	102.31	106.91
GA_3(200ppm)	115.12	109.13	10.49	12.66	32.85	33.33	13.91	14.41	83.16	83.92	520.34	548.53	435.96	447.42	23.41	22.38	106.27	106.91
SA(100ppm)	103.54	98.82	10.49	10.68	25.96	26.66	13.18	13.48	79.93	80.63	474.62	489.67	389.82	385.25	24.96	23.45	102.19	108.73
SA(150ppm)	105.78	100.86	10.82	11.42	26.59	27.79	13.40	13.67	80.25	81.11	493.73	484.87	391.24	396.34	24.22	23.44	103.42	104.23
SA(200ppm)	112.38	103.21	11.87	11.87	29.77	31.90	13.76	14.11	82.18	82.84	508.85	521.38	417.23	421.46	23.86	22.95	103.68	105.58

Fig.1 Effect of foliar application of PGRs on chlorophyll content (SPAD Value) in rice plant leaves under salt stress condition

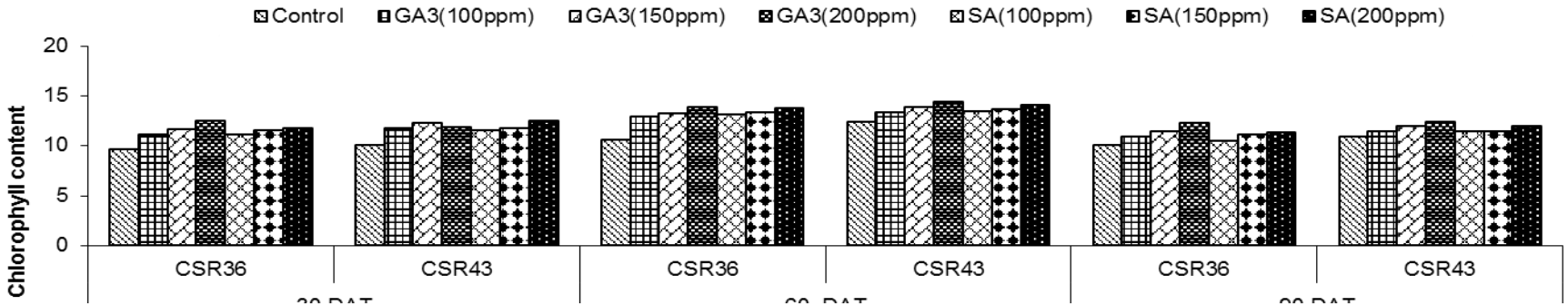
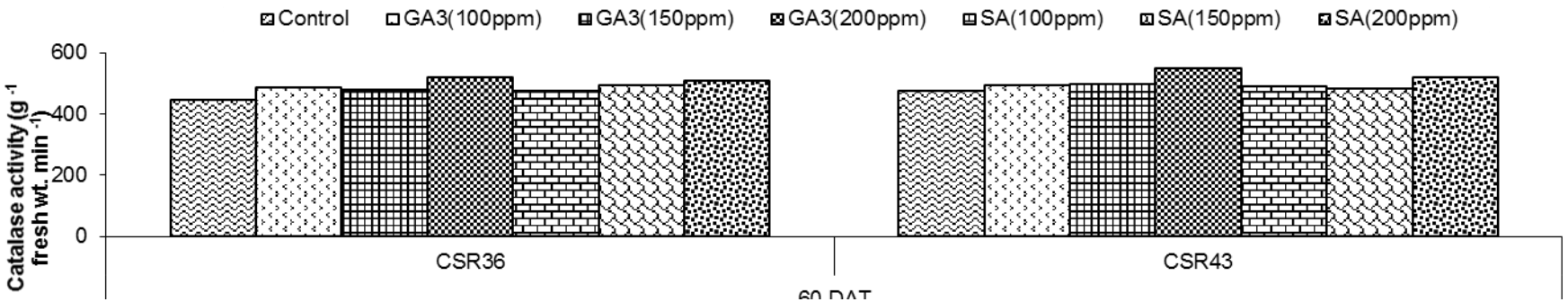


Fig.2 Effect of foliar application of PGRs on catalase activity (g $^{-1}$ fresh wt. min $^{-1}$) in rice plant under salt stress condition



Catalase and Peroxidase activity

Foliar application of GA_3 and salicylic acid impacted better improvement in enzymatic activities particularly catalase and peroxidase activities in green leaves at 60 DAT stage of rice crop. The maximum improvement in catalase and peroxidase activities was recorded with foliar sprayed of GA_3 200 ppm at 60 DAT followed by salicylic acid 200 ppm, while minimum catalase and peroxidase activities in green leaves were recorded in salicylic acid 100 ppm with respect to control. This might be due to catalase is detoxifine enzymes and remove free radicals hindering normal plant growth and development. It work as antioxidant in salt stress also enhanced the activities of such enzymes (Bandeogh *et al.*, (2004). α amylase promotes the hydrolysis of storage reserves (Yomon, 1960 and Paleg, 1960) which thereby improves crop stand and gave better production. It is through that GA_3 promote growth by increase plasticity of cell wall followed by the hydrolysis of starch to sugars. Which reduced the water potential in cell causing elongation. It is well established that GA_3 and SA regulate various process through life cycle of the plants. Similar finding their also Chen *et al.*, (1993, 1997) and Kasim and Dowidar (2000).

Sodium content in dry leaf

The higher mean value for sodium content in leaves was observed in control compare to other treatments, in both varieties CSR-36 and CSR-43. However, the accumulation of sodium was less in foliar application of GA_3 200 ppm followed by salicylic acid 200 ppm. The sodium ions have competitive effect with the absorption of potassium as result decrease their uptake. Enhance the uptake of sodium and decreased uptake of potassium under salt stress have been also reported by several researchers (Yanjun *et al.*, 1999, Velu and Srivastava, (2000).

Days to 50 % flowering and maturity

The results indicated that both the characters 50 % flowering and maturity duration showed maximum delayed with foliar application of GA_3 200 ppm over control. Both the characters were found non-significant delayed with increasing level of foliar sprayed of different doses of PGRs in comparison to control. Maximum deled was observed with the 50 % flowering and maturity duration in variety CSR-43 as compare to CSR-36. It may be because of foliar application of PGRs in delaying flowering and expansion maturity duration.

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