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Research Paper

Rice growth response in *Boro* and *Kharif* season under influence of number of seedling and hormone

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ABSTRACT

Field experiments were conducted in Replicated Split Plot Design at District Seed Farm "D" Block, Bidhan Chandra Krishi Viswavidyalya, Nadia, West Bengal, India during *Boro* and *Kharif* seasons of 2008-09, to assess the two plant growth regulators *viz*., GA_3 and phytonol, on growth and seed yield of rice crop cv. Shatabi (IET-4786) at panicle emergence stage. Besides untreated control, GA_3 was used at 10 ppm and 20 ppm, while for phytonol, it was used at 1ml and 2ml/3 l. of water. Significantly highest number of effective tillers/hill. (9.200), 100 seed weight (1.756g), yield/panicle (2.104g), and yield/ha (42.828 q) were recorded due to the treatment phytonol @ 2ml/3l. of water, as compared to control, while in a comparison between seasons, the maximum plant height was obtained during *Kharif* (97.43cm) as compared to boro(80.55cm), whether, reverse scenario was recorded in seed yield and other attributing characters. Single seedling transplanted plant produced maximum plant height and seed weight per panicle during *Kharif*, while the more number of tillers was obtained when plant was transplanted with triple seedlings.

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Key words : Phytonol, GA_3, Plant height, Seed index, 100-seed weight, Seed yield

INTRODUCTION

Rice (*Oryza sativa* L.) is an important cereal crop in developing countries, grown all over the world and it is the staple food of over half of the world's population, ranking second to wheat in terms of area cultivated as well as production. Out of total production of world, 91% yield is produced and consumed in Asia region, 5.8 % in America, 2.8 % in Africa and only 0.4 % in Europe. According to De Candolle (1886), India is the original home of rice due to availability of a large number of its wild forms.

Plant hormones and growth regulators are the chemicals that affect flowering, ageing, root growth, distortion and killing of leaves stems and other parts, prevent or promote stem elongation, prevent leafing and/ or leaf fall and other conditions. Very small concentrations of these chemicals are capable enough to create major growth changes, as referred. GA_3 and phytonol (Tricontanol) are such chemicals differing in its site and mode of action. Its only commercial use is as a plant growth regulator, and it has been widely patented for this use. It is a totally nontoxic, plant growth bio-regulator without any residual effect, produces stronger seedlings with better root system and finally develops into vigorous plants leading to better yield. It has been reported to stimulate stem elongation (Deotale *et al*., 1998) and increase dry weight (Hore, 1982) as well as yield (Deotale *et al*., 1998). GA_3 has been reported to increase number of pods in chick pea (Mange, 1997) and spikelet in rice. It is clear that GAs are implicated in several aspects of floral initiation in certain thermo periodic and photoperiodic plants (Evans, 1990). In spite of the fact that plant growth regulators modify the physiological process, it influences growth and may increase the yield of crops.

These are used by the farmers on very limited scale. The main limitation is that these chemicals/growth regulators are effective only at specific concentration. Similarly the appropriate stage of application of these growth regulators is also very important to exploit its beneficial effects (Nagoshi and Kowashima, 1996; Ravi

et al., 2007). Thus, the optimum concentration and right stage of the crop for application of these growth regulators are essential to have the desired results. Attempts have been made for utilization of such growth regulators for having higher yield in rice.

MATERIALS AND METHODS

Field experiments were conducted at District Seed Farm "D" Block, Bidhan Chandra Krishi Viswavidyalya, Nadia, West Bengal, India during *Boro* and *Kharif* seasons of 2008-09, to assess the two plant growth regulators *viz.,* GA_3 and phytonol, on growth and seed yield of rice crop cv. Shatabi (IET-4786) at panicle emergence stage.

The experiment was laid out in a split plot design with 15 treatment combinations of two factors: transplanting a single seedling (S_1) or double (S_2) or triple seedlings (S_3) in the main plot and spraying was initiated at panicle exertion stage of two concentrations of each GA_3 @ 10 ppm (T_1) and 20 ppm (T_2) and phytonol @ 1ml (T_3) and 2ml (T_4) in 3 l. of water along with untreated control. The each treatment combinations was replicated four times. In each replication, transplanting (single/double/ triple seedlings) was done in the main plots each of 10 x 9.5 meter with the spacing 20cm x 20cm, thus having 50 rows in each main plot. Spraying with each concentration of GA_3 or phytonol or water was made over plants on 10 consecutive rows. The observations were recorded at two days before harvesting from five random hills, which were uprooted from inner six rows of each sub-plot; the outer two rows on each side were left to avoid the effect of consecutive sprays, if any. Population from those five hills was subjected to take records of different parameters *viz*., plant height, number of effective tiller per hill, seed index, panicle length, seed yield per panicle and seed yield/ha.

RESULTS AND DISCUSSION

It could be revealed through Table 3 that all the characters were significantly influenced by number of seedlings transplanted except 100 seed weight and yield per panicle, which were found to be significant in boro season only. Whereas spraying treatment was able to create significant variation in all the characters. Significant variation was noted for 100 seed weight only due to interaction effect.

Plant height:

Significant decreasing trend in plant height was recorded for both the seasons along with the increased number of seedlings. Average plant height was higher in *Kharif* season in comparison to that in boro season irrespective of the number of seedlings transplanted. Spraying of both the hormones exhibited significant influence in enhancing plant height over the water sprayed control irrespective of the growing season. Maximum plant height was noted after application of GA_3 20ppm irrespective of growing season, though spraying of phytonol @ 2ml/3l water was also able in making plant height significantly similar to that by spraying of GA_3 @ 20 ppm in *Kharif* season. Similarly, the lower concentration of both the chemicals produced significantly similar plant height in both the seasons. Though insignificant, 20 ppm GA_3 when sprayed over single seedling transplanted plants, produced maximum height irrespective of the growing seasons (Table 1 and 2), which may be due to the fact that GA_3 20 ppm proved its role in cell elongation to the maximum extent. It is clear from Table 2 on change (%) in plant height that it was maximum for S_3 x T_2 (4.840%) in *Boro* and for S_1 x T_2 (3.086 %) in *Kharif* season. Increased plant height was also recorded by Katyama and Akita (1989) and Vasud *et al*. (1984) due to application of increased concentration of GA_3 through enhanced internodal elongation.

Number of effective tillers/hill:

Number of effective tillers was more, in general, during *Boro* season in comparison to that during *Kharif*. It was maximum for triple seedling transplanting (9.10 and 8.87, respectively) and was significantly in order of $S_3>S_2>S_1$ for its average performance in both the seasons, which may be due to the higher number of seedlings transplanted. Spraying of phytonol in higher dose influenced the production of highest average number of tillers per hill followed by GA_3 @ 20ppm, spraying of phytonol 1ml/3 l of water and spraying of GA_3@10 ppm irrespective of the seasons. Almost similar numbers of effective tillers were recorded after S_3xT_4 in both the seasons and it was the maximum value amongst different interaction combinations, though insignificant, which could also be confirmed through change per cent for this character. Phytonol apparently reacted in more advantageous way in comparison to GA_3 and thus influenced this character inducing change (%) in higher magnitude. The similar findings were corroborated with Vaiyapuri and Sriramachandrasekharan (2003) on production of higher number of tillers/hill due to tricontanol.

Panicle length (cm):

Single seedling transplanting led to the production of panicle with highest magnitude in both the seasons followed by S_2 and S_3, though S_1 and S_2 performed significantly in

Table 1: Variation in characters influence by different treatments on *Boro* season

S T	Plant height (cm)				Number of effective tillers/hill				Panicle length (cm)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
T_0	79.865	78.890	74.788	77.848	8.05	8.55	8.70	8.433	22.850	22.675	21.790	22.438
T_1	80.853	80.173	76.720	79.248	8.25	8.75	8.90	8.633	23.860	23.760	23.000	23.540
T_2	82.388	80.860	78.408	80.552	8.55	8.95	9.35	8.950	24.425	24.155	23.600	24.060
T_3	80.765	79.345	76.878	78.996	8.30	8.80	8.95	8.683	24.170	23.515	22.035	23.240
T_4	81.485	79.885	77.935	79.768	8.65	9.35	9.60	9.200	24.233	23.675	22.945	23.618
Mean	81.071	79.831	76.946		8.36	8.88	9.10		23.908	23.556	22.674	
	S.E. (±)	C.D.(P=0.05)	C.D.(P=0.01)		S.E. (±)	C.D.(P=0.05)	C.D.(P=0.01)		S.E. (±)	C.D.(P=0.05)	C.D.(P=0.01)	
S	0.3597	1.2449	1.8862		0.0521	0.1802	0.2730		0.2641	0.9140	NS	
T	0.2238	0.6420	0.8609		0.0501	0.1437	0.1927		0.1680	0.4819	0.6462	
(S_1T_1)vs(S_1T_2)	0.3877	NS	NS		0.068	NS	NS		0.2910	NS	NS	
(S_1T_1)vs(S_2T_2)or (S_1T_1)vs(S_2T_1)	0.497	NS	NS		0.0935	NS	NS		0.3708	NS	NS	
	100 seed weight (g)				Seed yield/panicle (g)				Seed yield q/ha			
T_0	1.737	1.675	1.672	1.695	1.928	1.899	1.817	1.881	37.174	37.210	37.339	37.241
T_1	1.739	1.707	1.687	1.711	1.986	1.957	1.863	1.935	39.038	39.487	39.781	39.435
T_2	1.746	1.732	1.730	1.736	2.126	2.095	2.058	2.093	40.513	42.245	42.820	41.861
T_3	1.739	1.737	1.736	1.737	1.996	1.962	1.880	1.946	39.454	40.036	40.313	39.931
T_4	1.790	1.741	1.739	1.756	2.152	2.129	2.031	2.104	41.667	42.982	43.834	42.828
Mean	1.750	1.718	1.713		2.038	2.008	1.930		39.569	40.392	40.817	
	S.E. (±)	C.D.(P=0.05)	C.D.(P=0.01)		S.Em (±)	C.D.(P=0.05)	C.D.(P=0.01)		S.E. (±)	C.D.(P=0.05)	C.D. (P=0.01)	
S	0.0092	NS	NS		0.0334	NS	NS		0.8411	NS	NS	
T	0.0057	0.0164	0.0220		0.319	0.0916	0.1229		0.8845	2.5369	3.4017	
(S_1T_1)vs(S_1T_2)	0.0099	0.00284	NS		0.0553	NS	NS		1.5320	NS	NS	
(S_1T_1)vs(S_2T_2) or (S_1T_1)vs(S_2T_1)	0.0127	0.0404	NS		0.0597	NS	NS		1.6078	NS	NS	

Table 2: Variation in characters influence by different treatments on *Kharif* season

S	Plant height (cm)				Number of effective tillers/hill				Panicle length (cm)			
T	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
T_0	95.688	95.178	93.878	94.914	8.10	8.25	8.50	8.283	26.970	26.685	26.090	26.582
T_1	97.455	96.345	94.983	96.261	8.20	8.50	8.70	8.467	27.870	27.315	26.215	27.120
T_2	98.640	97.605	96.030	97.425	8.50	8.80	8.85	8.717	28.263	27.370	26.845	27.493
T_3	97.108	95.655	95.393	96.052	8.40	8.45	8.75	8.533	27.020	26.935	26.205	26.720
T_4	97.650	97.490	95.968	97.036	8.70	9.00	9.55	9.083	27.105	26.950	26.960	27.005
Mean	97.308	96.455	95.250		8.38	8.60	8.87		27.438	27.051	26.463	
	S.E. (±)	C.D.(P=0.05)	C.D.(P=0.01)		S.E. (±)	C.D.(P=0.05)	C.D.(P=0.01)		S.E. (±)	C.D. (P=0.05)	C.D. (P=0.01)	
S	0.2220	0.7681	1.1638		0.0307	0.1063	0.1611		0.1498	0.5183	0.7853	
T	0.1628	0.4670	0.6262		0.0500	0.1434	0.1923		0.1683	0.4826	0.6471	
(S_1T_1)vs(S_1T_2)	0.2820	NS	NS		0.0866	NS	NS		0.2914	NS	NS	
(S_1T_1)vs(S_2T_2)or (S_1T_1)vs(S_2T_1)	0.3360	NS	NS		0.0833	NS	NS		0.3006	NS	NS	
	100 seed weight (g)				Seed yield/panicle (g)				Seed yield q/ha			
T_0	1.736	1.673	1.671	1.693	1.906	1.858	1.807	1.857	33.472	33.900	35.435	34.269
T_1	1.738	1.706	1.686	1.710	1.973	1.931	1.844	1.916	36.038	36.890	37.675	36.868
T_2	1.741	1.731	1.729	1.734	2.075	2.022	1.977	2.024	36.966	38.083	39.417	38.156
T_3	1.738	1.735	1.734	1.736	1.978	1.948	1.860	1.928	36.237	36.970	37.738	36.981
T_4	1.789	1.740	1.738	1.756	2.108	2.063	1.985	2.052	37.727	38.731	40.693	39.050
Mean	1.748	1.717	1.712		2.008	1.964	1.894		36.088	36.915	38.192	
	S.E. (±)	C.D. (P=0.05)	C.D. (P=0.01)		S.E. (±)	C.D. (P=0.05)	C.D. (P=0.01)		S.E. (±)	C.D. (P=0.05)	C.D. (P=0.01)	
S	0.0092	NS	NS		0.0211	0.0731	NS			NS	NS	
T	0.0057	0.0164	0.0222		0.0250	0.0718	0.0963		0.7061	2.0252	2.7156	
(S_1T_1)vs(S_1T_2)	0.0099	0.0284	NS		0.0434	NS	NS		0.4895	NS	NS	
(S_1T_1)vs(S_2T_2) or (S_1T_1)vs(S_2T_1)	0.0127	0.0404	NS		0.0442	NS	NS		1.1984	NS	NS	

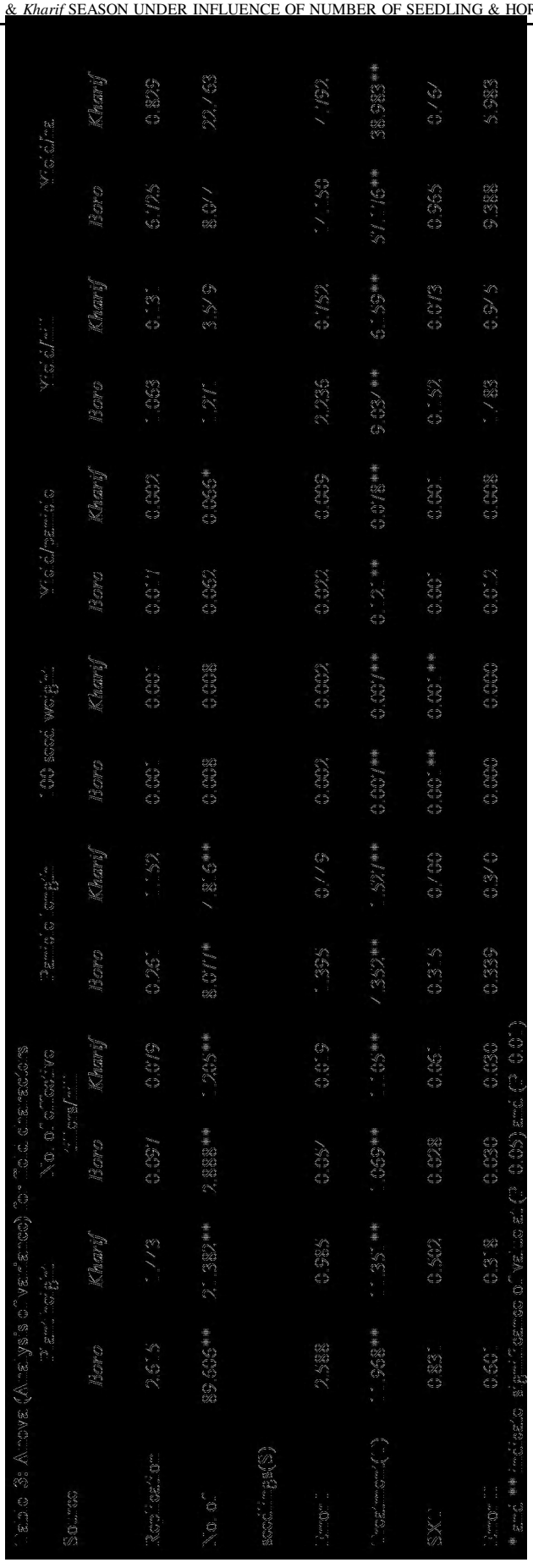
similar manner for expression of this character (Table 1 and 2). Whereas it was maximum for spraying of 20 ppm GA_3 followed by spraying of phytonol 2ml/3 l of water and spraying of GA_3 @10 ppm in *Boro* season (Table 1) and T_1 and T_4 in *Kharif* season (Table 2), though the performance of T_2 and T_4 was statistically at par in *Boro* season, and T_1 and T_2 in *Kharif* season. Maximum panicle length was recorded after S_1 x T_2 in both the season. Both the hormones played vital role in influencing either better exertion or elongation of panicles. Higher change (%) in panicle length was commonly associated with GA_3 spraying in comparison to phytonol and more particularly it was with 20ppm concentration, excepting for S_3 in *Kharif* season. Enhanced panicle length due to application of GA_3 was also noted by Kim *et al*. (1998).

Seed index:

While considering the individual influence of the main and sub-factors, it could be noted that number of seedlings transplanted did not create any significant influence on 100 seed weight in both the seasons, and the magnitude in performance was in order of $S_1>S_2>S_3$. While it was maximum for T_4 irrespective of the seasons *i.e., Boro* and *Kharif* followed by T_3, T_2 and T_1, though T_3 and T_2 were similar in performance for this parameter. Analysis of interaction effect indicates that highest seed index was recorded for (S_1XT_4) *i.e.,* spraying of phytonol 2ml/3 l of water on single seedling transplanted population in both boro and kharif season(Table 1 and 2). Production of high density seeds through application of phytonol irrespective of the number of seedlings transplanted may indicate the potential of the chemicals in creating suitable physiological activity in favour of seed development. Spraying of phytonol may apparently be considered as superior to that of GA_3 in influencing this parameter, which may be confirmed through change (%) in this character after application of the hormone. Application of phytonol, even in the lower concentration, induced change in higher magnitude (%) than the higher concentration of GA_3, excepting for single seedling transplanting in both the seasons. Tricontanol application at heading stage increased seed weight (Nagoshi and Kawashima, 1995) corroborates the findings of present investigation.

Yield per panicle:

Number of seedlings transplanted influenced significant variation in seed yield per panicle during *Kharif* season only (Table 1), and significant superior performance of single seedling transplanting was S_2 and S_3 did not differ between themselves. On the other hand, this parameter was significantly influenced by both the spraying hormones



in both the seasons. Average seed yield/panicle was maximum as recorded for T_4 followed by T_2 *i.e.,* higher concentration of both phytonol and GA_3, though they were statistically at par in *Boro* season. It indicated the favorable influence of both the chemicals in enhancement on its dependent parameters, particularly matured grain% (Kawashima *et al*., 1989). Though insignificant, the maximum seed yield per panicle (2.152 g and 2.108 g in *Boro* and *Kharif* seasons, respectively) was recorded for the combination S_1 x T_4, *i.e.,* spraying of phytonol @ 2ml/ 3 l of water on single seedling transplanted individuals. The change (%) over control due to spraying of those chemicals did not follow definite pattern, as could be revealed through. Highest per cent enhancement in these parameters was noted that 13.25 for S_3T_2 and 11.035 for S_2T_4 in *Boro* and *Kharif* season, respectively.

Seed yield per hectare:

Seed yield is the ultimate product of different yield contributing characters. T_4 *i.e.*, application of phytonol 2 ml/3 l. of water significantly influenced the production of seed yield per hectare with highest magnitude followed by significantly indifferent performer T_2 *i.e.,* application of GA_3 20ppm. Among the different number of seedlings transplanted, S_3 *i.e.,* three seedlings transplanted per hill exhibited the maximum average yield per hectare (q) in both the seasons followed by S_2 and S_1. While considering the interaction effect, it could be noted that when T_4 combined with S_3 produced maximum seed yield followed by T_4 x S_2 and T_2 x S_3 in both the seasons (Table 1 and 2). It was recorded in higher magnitude during *Boro* season (Table 1), as compared to that during *Kharif* season (Table 2), it is the general reflection in case of paddy as favourable environment prevails during seed development and maturation during *Boro* season. Similar to the expression in seed yield per hill, better influence of phytonol was recorded over that of GA_3 in both the seasons for both the characters studied as could be revealed through change (%) in those parameters. The similar results on seed yield was noted after GA_3 (25ppm) spraying, tricontanol induced little effect (Thangaraj and Sivasubramanian, 1992 and Ravi *et al*., 2007).

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