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Response of paddy (*Oryza sativa* L.) cultivars to bio-inoculants to early seedling growth

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ABSTRACT : The present study was carried out to evaluate the response of different bio-agents/ bio-inoculants/ bio-fungicides and growth regulators on seed germination and early seedling growth of rice genotypes. Giberallic acid(GA_3) and NAA were used as growth regulator and *Trichoderma viride*, *Pseudomonas fluorescens* and *Trichoderma harzianum* like bio-pesticides or bio -fungicides were used as bio-agents. Fifteen numbers of rice genotypes were used for studying the influence of bio-inoculants on seed germination and early seedling growth of rice. Fifteen different treatment combinations were used for investigation. Higher germination was observed in T_3, T_7 treatments in contrast to other treatments like chemicals as well as control. Generally root and shoot length increased with the advancement of growth stages. T_4 (*Pseudomonas fluorescens*) treated seeds showed higher number of secondary root (8.5 -15.8) in comparison to all other treatments in respect of all the genotypes. The shoot length, root length and seedling weight in all the rice genotypes cases were highly influenced by the bio-inoculants and chemicals but influence of bio-agents was found better than the chemicals. Similarly the seedling weight in both 96 hours after sowing and 144 hours after sowing in all the rice genotypes were reported higher when the seeds were treated with bio-inoculants which reflected the efficacy of the bio-inoculants like *Trichoderma viride*, *Pseudomonas fluorescens* and *Trichoderma harzianum* proved to be better than the rest.

Key Words : Rice genotypes, Bio-inoculants, Early seedling vigour

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Rice (*Oryza sativa* L.) is the staple food for half of the world's population especially in oriental countries. In India, about 2500 varieties of rice are being cultivated, from which more than 1200 varieties are in eastern India which are preferred over others, owing to their high yield, good quality and quantity of grain, short duration of growth and resistance against pest and diseases. A large number of experiments have been conducted in several countries to investigate the effect of inoculation of various strains of *Azospirillum* spp. on cereals and grasses (Smith *et al*., 1976; Watanabe *et al.*, 1981). The aim of the application of *Azospirillum* is to get fast growth, better health of the plant and higher yield. It is known to be a very active nitrogen fixer under laboratory as well as soil conditions. Various kinds of cereals were tested by using a member of nitrogen fixing bacteria *viz.*, *Azotobacter*, *Nitrosomonas* and *Azospirillum* to increase yield under controlled conditions. Balasubramanian and Kuamr, 1987; Wani, 1990; Bashan and Holgain, 1995 investigated that *Azospirillum* treatment showed remarkable increase in the grain and the straw yield in sorghum, wheat, maize, paddy and other food and fodder crops. The yield responses caused by *Azospirillum* inoculation may be due to biological nitrogen fixation (Hartmann *et al*., 1983). Split application of biofertilizer inoculation through seed, seeding and soil gave the highest grain, straw yield, plant height and number of productive tillers in rice (Gopalswamy and Vidhy asekaran, 1988). The objective of the present study was to investigate the effect of *Azospirillum* inoculation on the different paddy varieties to find out the best variety. The observations were made to note the seedling characters such as seed germination, biomass and phytomass yield of paddy varieties under controlled conditions.

RESEARCH PROCEDURE

The seeds were sterilized with 2 per cent mercuric chloride solution before treatment. After sterilization, the seeds were washed well with sterile distilled water. Twenty five seeds were

selected from each variety and dressed well with the solution of 250mg of *Azospirillum brasilense* in water. These seeds were dried under the shade condition and transferred after sowing to a plastic trough containing 2kg of sterilized garden soil. The troughs were watered regularly and being maintained under controlled condition. A control set up was also made by following the same conditions except the addition of bio-inoculants. Five seedlings were selected at random from each trough and the following observations were made on the 2nd, 4th and 6th day of plating. The seedlings were uprooted gently without causing any damage to the root and shoot systems. The shoot and root lengths were measured with a metric scale. The shoot and root fresh weights were determined using an electronic balance.

After every 12 hours the data on seed germination were recorded. Total number of germinated seeds were counted in all the treatments, at an interval of 12hours after soaking and recorded as emergence count / Petri plate. The data on shoot and root length were recorded at 48, 96 and 144 hours of seed soaking from 10 randomly selected seedlings. The seedling weight was recorded in 96 and 144 hours after soaking.

Present study was done using following material and method:

Treatments:

T_1 : *Trichoderma viride :* Strain -1 -20g/ l
T_2 : *Trichoderma harzianum* -20g/ l;
T_3 : *Pseudomonas fluorescens*—20g/ l
T_4 : *T. viride*-Str-1(5.0g/l) +P. *fluorescens*(5.0g/l)
T_5 : *T. viride*-Str-2(5.0g/l) +P. *fluorescens*(5.0g/l)
T_6 : Control :Double Distilled water
T_7 : *T. harzianum* (5.0g/l) +P. *fluorescens*(5.0g/l)
T_8 : Blitox (2.0g/l)
T_9 : Seed plus (Gibeeralic acid -10%)-2.0g/l
T_{10} : Sudha germinaid (Growth regulator)-1.0g/l
(Population density - 2 X 109 (c.f.u./g),
Microbial adjuvant - 2%,
Microbial media residue inert ingredient - 95-97%)

The experiment was conducted in Petriplate. Thirteen number of rice cultivars were used for the present study. Healthy, viable paddy seeds of thirteen varieties *viz.*, Sadamota, Banshkanta, Dudherswar, Nonabakra, Sarusilet, Gobindbhog, Gitanjali, Khejurchari, Nagranjit, Raniakanda, Anshfali, Moule and IR -36 were collected from local farmer. 50 numbers of paddy seeds were placed on the filter paper within the Petri plate. 5 ml of liquid solution of each treatment was applied on the filter paper at every 24 hours intervals. After every 12 hours the data on seed germination were recorded. Total number of germinated seeds were counted in all the treatments, at the interval period of 12hours after soaking and recorded as emergence count / Petri plate. The data on shoot and root length were recorded at 96, 120 and 144 hours of seed soaking from 10 randomly selected seedlings. The seedling weight was recorded in 96 and 120 hours after soaking.

For growth study, height of ten randomly selected seedlings from each treatment and each replication was measured with a meter scale from the ground level to the tip of the shoot, (shoot length) and mean height was calculated from each treatment. The seedling weight (g) was measured in 96 and 120 hours after sowing in similar fashion. Root lengths of 10 randomly selected seedlings from each treatment were measured with a meter scale.

RESEARCH ANALYSIS AND REASONING

The results indicated that the growth of *Trichoderma viride, Trichoderma harzianum, Pseudomonas fluorescens* or their combinations treated paddy seedlings excelled over the untreated ones. Germination Counts: The germination percentage was influenced by different treatments (Table 1, Plate 1). Result showed that the maximum number of seedling emergence was reported in T_1 (94%) and T_8 treatment (96%), which contains bio-agents (*T. viride*-Str-1 -(10.g/l and 5g/l) which was at par with T_{13} (Blitox 2.0g/l) and T_{17} (Sudha germinaid growth regulator-1.0g/l). In all the treatments, the germination percentage was significantly higher than the control .The results indicate that the bio-agents like *T. viride*, *T. harzianum* and *P. fluorescens* had similar type of influence on seed germination like growth regulator and chemicals. The conclusion of the present study is that *T. viride*, *P. fluorescens* and *T. harzianum* and their combinations had significant role on seed germination and early seedling growth and all the bio-agents either in combination or individually proved to be a booster as a bio-fertilizers/bio-stimulant and reported at par with the growth regulators in relation to seed germination and early seedling growth .

The seed germination studies revealed that the percentage germination of seeds were highest in *Trichoderma harzianu* combination *with Pseudomonas fluorescens* (5.0g/l +5.0g/l) followed by *Trichoderma harzianu* (10.0g/l) and Sudha germinaid (growth regulator)-1.0g/l, seed plus (Gibberelic acid -10%)-2.0g/l and Blitox (2.0g/l), respectively, the fungal growth was best checked when the seed treated blitox(no infection) followed by *Pseudomonas fluorescens*(<5% infection), *P. fluorescens combined with Trichoderma harzianu* (<10% infection). The inoculation of the bio-fungicide in the varieties like Raniakanda, Saru shelet, Banskantha, Moule, Gobindbhg, Anshfali, Nagranjit, Khejurchari ,Gitanjali and IR-36 showed a considerable increase in the seed germination than the other varieties under same experimental conditions. The reason for this may be due to the tremendous pressure developed inside the seeds, which is responsible for breaking of the seed coat quickly (Sifton, 1959). This pressure may be induced by phytohormones especially auxin, indole acetic acid(IAA), cytokinin and gibberelic acid(GA) like substances secreted by *Trichoderma harzianu* or *P. fluorescens* or *Trichoderma viride*.

Table 1 : Effect of different treatments on germination percentage of different varieties

	Germination (%)																			
	T_1		T_2		T_3		T_4		T_5		T_6 (Control)		T_7		T_8		T_9		T_{10}	
	96 hrs	144 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	144 hrs	96 hrs	144 hrs	96 hrs	144 hrs	96 hrs	144 hrs	96 hrs	144 hrs
Arjirban	45	55	45	55	50	60	50	60	45	55	40	45	50	60	55	65	50	60	50	60
Sadamota	75	80	65	60	35	45	40	50	65	75	45	50	65	70	60	65	50	60	50	60
Nonabokra	90	100	90	100	95	100	90	100	85	100	85	90	90	95	85	90	95	100	90	100
Dudherswar	75	80	80	100	90	95	75	80	75	90	50	60	75	90	75	90	75	85	75	85
Moule	50	65	55	65	50	60	50	60	55	70	40	45	50	60	55	65	50	60	50	60
Saru shelet	45	55	45	55	50	60	50	60	45	55	30	40	50	55	50	55	45	55	45	50
Raniakanda	40	50	45	55	40	55	40	55	45	60	30	40	45	55	45	55	45	60	45	55
Banshkanta	45	55	45	55	40	55	45	60	45	55	40	45	55	65	60	70	45	65	50	55
Gobindbhg	50	65	50	60	45	60	50	70	45	65	30	40	55	65	50	65	50	60	55	65
Anshfali	45	65	45	55	40	65	40	65	45	70	30	35	45	60	40	60	45	65	40	60
Nagranjit	50	65	50	65	55	70	50	70	55	75	35	45	55	65	50	60	50	70	50	65
Khejurchati	50	65	45	65	50	70	55	70	50	65	30	40	55	60	45	60	50	65	45	65
Gitanjali	40	60	45	60	45	65	50	70	50	65	25	30	40	50	50	65	45	65	40	60
IR-36	55	65	60	75	55	70	60	75	50	65	45	55	60	70	55	70	50	65	50	65
LSD(P=0.05)	5.6	7.8	6.3	8.2	5.5	6.4	5.8	7.2	4.9	6.8	5.1	7.3	6.4	8.3	6.7	8.4	7.2	9.1	7.6	9.5
GxE :						0.52														

Table 2 : Effect of different treatments on shoot and root length of different varieties

	Shoot and root length (cm)																			
	T_1		T_2		T_3		T_4		T_5		T_6 (Control)		T_7		T_8		T_9		T_{10}	
	96 hrs	144 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	144 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs
Arjirban	1.60	6.12	1.75	6.45	1.68	6.10	0.92	6.00	1.52	6.40	1.45	3.10	1.75	4.35	1.55	4.65	1.25	4.20	1.52	4.00
Sadamota	1.25	7.55	1.36	7.10	1.18	7.10	1.38	6.85	1.21	6.60	1.02	5.00	1.24	6.50	1.14	5.00	1.38	5.50	1.21	5.10
Nonabokra	1.40	6.55	1.05	7.45	1.31	6.50	1.24	6.50	1.40	8.00	1.30	5.50	1.51	6.50	1.25	7.60	1.24	5.50	1.4	5.20
Dudherswar	0.86	5.25	1.16	5.56	0.89	5.50	1.21	5.40	1.16	5.65	0.81	4.50	0.91	5.50	1.05	6.00	1.21	4.90	1.16	4.70
Moule	1.35	5.38	1.41	5.80	1.45	4.50	1.12	4.10	1.06	4.35	0.82	4.80	0.94	5.60	1.12	6.00	1.12	4.60	1.06	4.40
Saru shelet	1.60	6.12	1.75	6.45	1.65	6.10	0.95	6.00	1.52	6.40	1.45	3.00	1.75	4.25	1.51	4.55	0.95	4.20	1.52	4.00
Raniakanda	1.62	6.92	1.28	6.50	1.58	6.90	1.35	6.80	1.85	6.80	0.91	4.00	2.10	5.60	1.48	5.50	1.15	5.75	1.85	5.50
Banshkanta	2.12	6.10	1.98	6.80	2.24	7.10	2.14	7.30	2.04	7.60	1.82	4.50	1.50	5.60	2.41	4.60	2.14	4.55	2.04	4.30
Gobindbhg	0.85	3.12	0.79	3.24	0.89	3.56	0.95	3.40	0.81	3.50	0.65	2.15	0.81	2.80	0.89	2.65	1.08	3.20	0.81	2.70
Anshfali	1.75	7.50	1.65	7.10	1.67	8.10	0.78	3.70	0.85	3.60	1.18	2.80	1.62	3.20	1.20	3.50	0.92	2.80	0.85	2.80
Nagranjit	1.58	4.12	1.48	4.45	1.45	4.65	1.65	4.60	1.12	4.50	0.86	1.50	1.46	2.90	1.35	1.20	1.70	5.40	1.12	3.40
Khejurchati	1.75	4.70	1.81	5.60	1.85	5.60	1.72	4.80	1.65	5.10	1.35	3.50	1.71	3.50	1.65	4.60	1.78	5.70	1.65	5.00
Gitanjali	1.82	5.80	1.95	6.30	1.75	5.40	1.81	5.20	1.72	5.30	1.12	3.40	1.87	4.20	1.62	3.80	1.75	5.30	1.72	5.20
IR-1036	2.28	6.70	2.68	6.80	2.48	6.50	2.62	6.30	2.78	6.60	1.92	5.20	2.35	5.90	2.45	6.20	2.65	6.90	2.78	6.60
LSD(P=0.05)	0.28	0.65	0.15	0.78	0.21	0.92	0.32	1.20	0.38	1.10	0.24	1.15	0.15	1.21	0.41	1.36	0.42	1.40	0.32	1.40
GxE :			6.5													0.71				

Table 3 : Effect of different treatments on root length of different varieties

Name of variety	Root length (cm)																			
	T_1		T_2		T_3		T_4		T_5		T_6 (Control)		T_7		T_8		T_9		T_{10}	
	96 hrs	144 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	144 hrs	96 hrs	144 hrs	96 hrs	144 hrs	96 hrs	144 hrs	96 hrs	144 hrs
Arjirban	2.20	6.20	1.60	3.25	2.45	5.40	2.60	7.90	1.70	3.85	1.90	4.40	2.20	5.70	2.60	4.90	2.30	4.40	2.10	4.50
Sadamota	3.00	5.50	2.50	5.00	2.00	4.50	2.20	5.50	2.50	5.70	2.20	4.20	2.20	5.20	3.00	5.50	2.30	4.00	2.35	3.60
Nonabokra	3.50	5.70	3.00	7.50	3.00	8.00	2.80	6.00	2.35	8.00	2.00	5.00	4.00	5.50	3.60	5.00	2.60	5.20	2.55	6.10
Dudherswar	2.10	7.20	2.50	7.00	2.25	6.00	1.70	5.50	2.00	5.50	1.75	6.50	2.20	5.80	1.90	4.60	2.20	5.00	2.25	5.10
Moule	2.50	5.50	2.50	7.00	1.40	7.00	2.60	6.50	2.70	6.00	2.10	3.50	2.60	3.80	2.00	7.00	2.50	4.50	2.40	5.50
Saru shelet	2.40	6.00	1.30	3.25	2.40	5.20	2.50	7.80	1.50	3.65	1.80	3.60	2.50	4.60	3.25	5.40	2.50	3.20	2.20	4.20
Raniakanda	3.50	6.00	3.50	6.50	4.00	4.70	2.50	4.50	3.30	5.20	2.50	4.50	2.80	3.80	3.10	5.20	3.00	4.20	3.10	4.20
Banshkanta	2.40	3.75	2.30	4.00	2.00	3.50	2.40	4.20	2.60	5.00	2.60	5.00	2.90	6.20	3.20	5.80	3.20	5.0	3.00	5.00
Gobindbhg	2.30	6.90	2.40	6.80	1.90	5.60	2.50	6.00	2.60	5.40	1.90	4.20	2.30	5.40	2.20	4.50	2.10	4.50	2.30	4.30
Anshfali	2.20	5.10	2.50	6.30	2.20	5.50	2.60	5.90	2.70	6.20	1.80	3.60	2.40	5.60	2.40	4.60	2.00	4.20	2.40	4.20
Nagranjit	3.25	6.10	3.45	4.70	3.00	4.60	3.20	6.00	3.30	6.60	1.60	4.00	2.50	6.00	2.30	4.70	2.60	5.50	3.00	5.60
Khejurchati	2.70	4.90	2.80	6.20	2.40	5.20	2.70	5.70	2.80	6.90	1.70	4.20	2.30	6.20	2.50	5.10	2.40	4.70	2.10	4.50
Gitanjali	2.90	5.10	2.70	5.90	2.20	5.10	2.30	5.40	2.30	6.10	1.90	4.50	2.20	5.60	2.50	4.70	2.30	4.20	2.00	4.30
IR-1036	3.20	6.50	3.40	6.90	2.80	6.20	3.00	6.50	3.10	7.20	2.50	5.20	3.20	6.80	2.90	6.40	3.20	6.50	2.90	6.70
LSD(P=0.05)	0.25	0.66	0.53	1.66	1.55	1.65	0.39	1.63	0.55	1.88	0.55	1.61	0.42	1.35	0.72	1.81	0.72	1.70	0.83	1.72
GxE :													0.51							

Table 4 : Effect of different treatments on seedling weight of different varieties

Name of variety	Seedling weight (g)																			
	T_1		T_2		T_3		T_4		T_5		T_6 (Control)		T_7		T_8		T_9		T_{10}	
	96 hrs	144 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	120 hrs	96 hrs	144 hrs	96 hrs	144 hrs	96 hrs	144 hrs	96 hrs	144 hrs	96 hrs	144 hrs
Arjirban	0.84	1.45	0.70	1.55	0.74	1.80	0.76	1.85	1.10	1.85	1.90	4.40	2.20	5.70	2.60	4.90	2.30	4.40	2.10	4.50
Sadamota	0.78	1.22	0.89	1.36	0.65	1.40	0.82	1.42	0.73	1.56	2.20	4.20	2.20	5.20	3.00	5.50	2.30	4.00	2.35	3.60
Nonabokra	0.75	1.35	0.79	1.41	0.72	1.54	0.86	1.46	0.75	1.83	2.00	5.00	4.00	5.50	3.60	5.00	2.60	5.20	2.55	6.10
Dudherswar	0.90	1.41	0.88	1.52	0.81	1.45	0.96	1.61	0.81	1.59	1.75	6.50	2.20	5.80	1.90	4.60	2.20	5.00	2.25	5.10
Moule	0.84	1.45	0.72	1.57	0.77	1.74	0.75	1.77	1.00	1.79	2.10	3.50	2.60	3.80	2.00	7.00	2.50	4.50	2.40	5.50
Saru shelet	0.98	1.52	1.10	1.52	0.80	1.60	1.25	1.65	0.66	1.48	1.80	3.60	2.50	4.60	3.25	5.40	2.50	3.20	2.20	4.20
Raniakanda	1.08	1.28	1.10	1.31	1.02	1.45	1.31	1.74	0.80	1.35	2.50	4.50	2.80	3.80	3.10	5.20	3.00	4.20	3.10	4.20
Banshkanta	1.12	1.65	1.25	1.55	0.92	1.68	1.45	1.89	0.82	1.12	2.60	5.00	2.90	6.20	3.20	5.80	3.20	5.0	3.00	5.00
Gobindbhg	0.42	0.85	0.36	0.78	0.40	0.70	0.55	0.62	60.0	0.95	1.90	4.20	2.30	5.40	2.20	4.50	2.10	4.50	2.30	4.30
Anshfali	1.20	1.86	1.00	1.62	0.90	1.60	0.95	0.90	0.82	1.30	1.80	3.60	2.40	5.60	2.40	4.60	2.00	4.20	2.40	4.20
Nagranjit	0.75	1.18	0.65	1.32	0.80	1.49	0.89	1.58	0.66	0.72	1.60	4.00	2.50	6.00	2.30	4.70	2.60	5.50	3.00	5.60
Khejurchati	0.62	1.36	0.76	1.45	0.68	1.32	0.60	0.95	0.55	0.88	1.70	4.20	2.30	6.20	2.50	5.10	2.40	4.70	2.10	4.50
Gitanjali	0.55	1.35	0.63	1.45	0.55	1.00	0.90	1.15	0.60	0.85	1.90	4.50	2.20	5.60	2.50	4.70	2.30	4.20	2.00	4.30
IR-1036	1.25	1.90	1.15	1.82	1.25	1.95	1.35	2.25	1.25	2.10	2.50	5.20	3.20	6.80	2.90	6.40	3.20	6.50	2.90	6.70
LSD(P=0.05)	0.2	0.3	0.12	0.33	0.18	0.41	0.16	0.39	0.63	1.93	0.17	0.36	0.22	0.45	0.25	0.63	0.28	0.48	0.31	0.55
GxE :													0.37							

The findings shows close proximity with Okon (1985) and Okon and Kapulnik (1986) in case of a biofertilizer, *Azospirillum*.

The observations made on 2nd, 4th and 6th days of sowing revealed that bio-inoculums treated seeds had higher early seedling development than the control. The seedlings from this particular bio-inoculant treated seeds had longer shoot and root lengths than the untreated ones. Similar results were observed in other plant species. From our experimental findings it may be concluded that the seed dressing by these bio-inoculants induced the production of plant growth promoting substances and led to the increase of shoot and root length (Table 2). Secretion of plant growth hormones by *Azospirillum* was reported in several cereals and grasses (Balasubramanian and Kuamr, 1987, Bashan and Holgain, 1995). This also reflects a specific capability of the host plant to attract the bacteria and modify the rhizosphere and/or to respond to some bacterial activity and benefit from it (Bottini *et al.*, 1989). The fresh and dry weights of root and shoot system of paddy varieties were also found to be increased to a considerable extent in *Trichoderma harzianum* combination with *Pseudomonas fluorescens* (5.0g/l +5.0g/l) followed by *Trichoderma harzianum* (10.0g/l) treated seedlings (Table 3 and 4). T_4 (*Pseudomonas fluorescens*) treated seeds showed higher number of secondary root (8.5 -15.8) in comparison to all other treatments. This may be due to the formation and development of numerous root branching, root hairs and primary and secondary lateral roots which increases the nutrient uptake capacity of roots (Gopalswamy and Vidhyasekaran, 1988; Hartmann *et al.*, 1983). This effect on the root system as well as more root colonization and root proliferation are probably due to the growth hormones secreted by the bacteria or fungi. The increased nitrogen uptake from the soil might have correspondingly increased the biomass to some extent. The changes in root functions due to *Azospirillum* treatment in different wheat cultivars were also reported. These growth enhancing effects are of interest because of their potential significance for yield increase in agronomic systems in which the use of fertilizers is the limiting factors for their development (Sarig *et al.*, 1984). It may be due to the absorption of nutrients from the growing media and stimulate the metabolism of photosynthesis. Photosynthetic activity plays an important role in the increase of leaf area leading to more biomass accumulation. The plants like *Digitaria decumbens, Panicum maximum* and *Pennisetum americanum* were subjected to *Azospirillum* inoculation and observed that the photosynthetic rate and dry matter contents were increased to a limited extent (Smith *et al.*, 1976; Sarig *et al.*, 1984).

The increased chlorophyll content could be correlated with the high level of photosynthesis, this might be due to uptake of more nitrogen from the growing media, and for this activity the working bacteria or fungi or artificial growth innaculants have found to be a great importance. The experimental findings may be due to increasing level of protein content which may be due to the presence of kinetin which promotes the amino acid content which in turn helps in active protein synthesis (Tien *et al.*, 1979). Similarly, the findings may be due to increasing level of sugar content in the leaves might also be due to active role of bio/artificial inoculant in sugar metabolism (Watanabe *et al.*, 1981). The results clearly showed that paddy varieties like, Moule, Gobindbhog, Anshfali, Nagranjit, Khejurchari and Gitanjali, were accounted well in response to bioinoculants followed by Raniakanda, Saru shelet, Banshkanta and IR-36. Other varieties also showed low to medium response.

From these observations, it can be concluded that among the paddy varieties tested in response to *Trichoderma harzianum, T.viride* alone or combined *with Pseudomonas fluorescens* inoculation, high responsive varieties like Gobindbhg, Anshfali, Nagranjit, Khejurchari and Gitanjali had high phytomass and biomass accumulation, physiological and biochemical parameters. The beneficial effect of *Trichoderma harzianum ,T.viride* and *Pseudomonas fluorescens* on paddy varieties varies itself which depend upon the plant varieties, microbial strains, and genotypes X microbial strain interaction and might be other environmental factors particularly soil temperature, pH, Ec, moisture content and water holding capacity.

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