

Original Research Article

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Effect of Organic Manures and Bio-Inoculants on Growth, Yield and Quality of Rice (*Oryza sativa* L.)

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ABSTRACT

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A field experiment was conducted to evaluate the response of manurial treatment and bio inoculants on growth, yield and quality of rice at Agricultural Research Farm of Banaras Hindu University during *kharif* season of 2015. The experiment comprised four manurial treatment in main plot and four bio inoculants in sub plot. Experiment was laid out in split plot design and replicated thrice. The results indicated that significantly higher growth attribute, yield attribute and quality parameter of rice were recorded with the application of 50 % of RDN as FYM + 50% as vermicompost (MT-3). Among the bio inoculants treatments, PSB + *Azotobacter/Rhizobium* resulted in significantly higher growth, yield and quality parameters and remains at par with application of PSB.

Introduction

Rice (*Oryza sativa* L.) provides more than half the daily food for one of every three persons in the world, especially for south-eastern Asia, where 90% of the world production of rice are grown and consumed. At global level, it occupies an area of about 163.51 million ha with production and productivity of 498.65 million tonnes and 4.55 tonnes/ha, respectively (USDA, 2018). India ranks first in respect of area 44.50 million ha second in

production 115.63 million tonnes with average productivity 3.90 tonnes/ha (USDA, 2018). The burgeoning population pressure has forced many countries to use chemicals and fertilizers to increase the farm productivity for meeting their ever increasing food requirements. The prolonged and over usage of chemicals has, however, resulted in human and soil health hazards along with environmental pollution. Supplementation of entire N through FYM sustains crop productivity at much lower level. Since, the

estimates of NPK availability from organic sources are based on total nutrient content, efficiency of these sources to meet the nutrient requirement of crops is not as assured as mineral fertilizers but the conjoint use of chemical fertilizers along with various organic sources is capable of sustaining higher crop productivity, improving soil quality and productivity on long term basis (Yadav *et al.*, 2013). The soil flora and fauna play an important role in soil development. Microbiological activity in the root zone is important to soil acidity and for nutrient cycling. Microbial inoculants, so-called biofertilizers, are a promising technology to reduce the use of conventional inorganic fertilizers. Many of them can serve as biofertilizers as they are able to fix nitrogen (N), help to access nutrients such as phosphorus (P) and N from organic fertilizers and soil stocks, improve drought tolerance, improve plant health or increase salt tolerance (Vessey, 2003).

Materials and Methods

The field experiment was conducted during *kharif* season 2015 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India located at 25° 18' N latitude, 83° 03' E longitude and at altitude of 75.7 MSL of Indo-Gangetic region of eastern U.P. (India). The soil of experimental site was sandy clay loam, 7.32 soil pH (pH meter), 0.40% organic carbon (Walkley and Black, 1934), 180.50 kg/ha available nitrogen (Subbiah and Asija, 1956), 18.34 kg/ha available phosphorus (Olsen *et al.*, 1954) and 208.42 kg/ha available potassium (Jackson, 1973). The experiment was laid out in split plot design consisting 16 treatment combinations and were replicated thrice. The experiment comprised four manurial treatment *viz.* 100% of RDN as FYM (T₁), 100% of RDN as Vermicompost (T₂) 50% of RDN as FYM + 50% as

Vermicompost (T₃) 100% of RDN through inorganic sources (T₄) assigning to main plot. Four bio inoculants *viz.* Control (T₁), *Azotobacter/Rhizobium* (T₂), PSB (T₃), PSB + *Azotobacter/Rhizobium* (T₄) were allocated to subplot. Recommended doses of nitrogen, phosphorus and potassium (N, P₂O₅ and K₂O) were supplied through urea (46% N), DAP (46% P₂O₅ and 18% N) and muriate of potash (60% K₂O) respectively. Uniform basal application of phosphorus and potassium was made to all the plots. Half dose of nitrogen was applied as basal and remaining half dose applied in two equal splits at tillering and panicle initiation stages as per treatment requirement. Quantity of FYM and vermicompost to be applied were calculated as per their treatment requirement and thoroughly spread and mixed into respective plots. Bio inoculants were mixed with FYM and vermicompost as per treatment requirement before transplanting. Seedlings of 25 days old were transplanted at 20 × 15 cm spacing under puddle conditions. The other crop management practices were followed as per standard recommendations. Five hills in the net plot area were randomly selected and tagged for recording the observation.

Results and Discussion

Growth attributes

The data presented in Table 1 indicated that plant height increased with advancement in crop age up to 90 DAT (days after transplanting). The highest plant height was recorded with treatment MT-3 (50% of RDN as FYM + 50% as vermicompost), followed by MT-2 (100% of RDN as vermicompost); whereas the minimum plant height at 90 DAS (92.3 cm) was observed in MT-4 (100% of RDN through inorganic sources). Among the bio inoculant treatments, BI-4 recorded significantly taller plants at harvest (104.6 cm) which were at par to that recorded with

application of BI-3. Manurial treatments had significant effect number of tillers per m² at all the stages of crop growth. The MT-3 produced significantly higher number of tillers than other treatments. Among different bio inoculants treatments, BI-4 recorded significantly highest number of tillers per m² which was statistically similar to application of BI-3 followed by BI-2.

The highest dry matter was recorded with treatment MT-3 (50% of RDN as FYM + 50% as vermicompost), followed by MT-2 (100% of RDN as vermicompost); whereas the minimum drymatter was observed in MT-4 (100% of RDN through inorganic sources). Among the bio inoculant treatments, BI-4 recorded significantly higher dry matter at harvest) which were at par to that recorded with application of BI-3. Govindan and Bagyaraj (1995) also conduct the field experiment of rice with biofertilizers inoculation and reported that biofertilizers inoculation enhanced shoots and root growth. Similar results are found by Rodriguez and Fraga (1996). This is in agreement with the findings of Devasenamma *et al.*, (1999) and Nayak *et al.*, (1986). Prasad and Singh (1984) also reported the combined effect of inoculation of biofertilizers in rice with application of N increased number of tillers, growth, nutrient uptake and yield of rice.

Yield attributes and quality parameter

The highest yield (4347 kg ha⁻¹), yield attributes and quality parameters were recorded with treatment MT-3 (50% of RDN as FYM + 50% as vermicompost), followed by MT-2 (100% of RDN as vermicompost); whereas the minimum yield, yield attributes and quality parameters were observed in MT4

(100% of RDN through inorganic sources). Among the bio inoculant treatments, BI-4 recorded significantly higher yield, yield attributes and quality parameters which were at par to that recorded with application of BI-3. Meena *et al.*, (2019) reported that increase N level brought about significant increase in grain yield. The grain yield of rice was also increased by inoculation of biofertilizers (Jayaraman, 1990). The increase in yield due to biofertilizers inoculates may not be solely due to N fixation or phosphate solubilization, but because of several other factors such as release of growth promoting substances, control of plant pathogen, proliferation of beneficial organism in the *Azotobacter* and PSB. These findings are in accordance with Kundu and Gaur (1982). Solubilizations of inorganic phosphate in the soil (PSB) make them available to the crop and resulted in better yield. It also produced a phytohormone (IAA) which increased its nutrient absorption capacity from the soil. These findings were in accordance with Datta *et al.*, (1994) and Mudenoor (2002). The response to mixed culture inoculation was more than that for single culture, showing the synergistic effect of two types of organism. The significant response was mainly due to the supply of two major nutrients N and P. Significant positive yield response in transplanted rice observed a statistically with biofertilizers (Rao *et al.*, 1983) and N fertilizers (Meena *et al.*, 2018).

From present study it can be concluded that application of 50 % of RDN as FYM + 50% as vermicompost is good option for significantly higher growth attribute, yield attribute and quality parameter of rice. Among the bio inoculants PSB + *Azotobacter/Rhizobium* resulted in significantly higher growth, yield and quality parameters of rice.

Table.1 Effect of manurial treatments and bio inoculants on growth, yield and quality parameter of rice

Treatments	Plant height (cm)	Number of tillers/m ²	Crop dry matter accumulation (g/m ²)	Effective tillers/m ²	1000 grain weight	Grain yield (kg/ha)	Straw yield (kg/ha)	Hulling percentage
Manurial Treatment (MT)								
MT-1	96.6	262	828	236	26.2	3917	4766	78.3
MT-2	103.8	276	872	246	27.9	4059	5022	77.7
MT-3	105.9	302	953	264	28.6	4347	5486	76.9
MT-4	92.3	235	749	198	26.7	3288	4107	79
SEm±	1.7	7.1	24	6	0.4	108	138	0.7
CD at 5%	6	26	84	23	NS	383	484	NS
Bio Inoculant (BI)								
BI-1	99.3	238	755	207	25.9	3474	4302	76.6
BI-2	101.9	302	954	263	27.6	4375	5439	79.3
BI-3	101.1	287	913	257	27.2	4195	5212	78.3
BI-4	104.6	306	965	272	28.1	4517	5508	80.5
SEm±	1.1	6	17	5	0.3	82	104	0.5
CD at 5%	3.4	18	53	16	0.9	237	301	1.6

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