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Root parameters and grain quality of lowland rice as affected by different nutrient management practices and microbial inoculants

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Abstract
A field study was conducted during *Kharif* 2016 at the research farm of ICAR Complex for NEH Region (Umiam) Barapani, Meghalaya to find out the effect of different nutrient management practices and microbial inoculants on root parameters and grain quality of lowland rice in Eastern Himalayas. The experiment was laid out in split plot design with 12 treatment combinations and 3 replications. The main plots were consisted of 3 different nutrient management practices viz. 100% organic, 100% inorganic (RDF) and INM (75% RDF+ 25% FYM) while in the sub plot there were 4 treatments viz. control, *Azospirillum*, *Azospirillum* + PSB, *Azospirillum* + PSB + ZnSB. The results showed highest grain yield (4.27 t/ha) was recorded in INM followed by inorganic (4.08 t/ha) and organic (3.65 t/ha) nutrient management practice. The root growth parameters and better grain quality were observed in organic nutrient management practice followed by INM and inorganic nutrient management. Application of inorganic nutrient practice including mineral fertilizers at RDF showed the highest value of protein contents (7.86%) and this was followed by INM (7.75%) and organic (7.07%) management. The maximum concentrations of Zn in grain (18.65 ppm) were recorded with organic nutrient management practice was significantly higher over INM and inorganic treatment. The highest hulling percentage (68.68%) was recorded in inorganic followed by INM and organic treatment while highest milling (58.81%) and head rice recovery (51.06 %) was recorded in organic followed by inorganic and INM treatment.

Keywords: lowland rice, nutrient management practices, microbial inoculants, yield attributes, yield and profitability

Introduction
Rice is a staple food of more than 50% of the world's population. Rice is the major staple food crop in India, occupying around 45 mha and accounts for 40% of the nation's food production and it is a staple food of around 65% total population. Rice-based production systems provide the main source of income and employment for more than 50 million households (Vaid *et al.*, 2014) [13].

As an integral part of plant, roots are involved in acquisition of water and nutrients, anchorage of plants, synthesis of plant hormones and also are the site of interaction with soil bacteria (Sainju *et al.*, 2005) [10]. The activity and growth of roots are assumed to mutually interact with the shoots. The size and area of the absorbing surface, directly depends on the amount of nutrient absorption by the plants (Sattelmacher, 1993) [11]. A high photosynthetic rate of leaves secures high root activity by providing a sufficient amount of photosynthates to the roots. Conversely, high root activity also helps in attaining high photosynthetic rate by supplying a sufficient amount of water and nutrients to above ground plant parts, thus ensures high productivity (Osaki *et al.*, 1997) [8]. Martino (1994) [6] reported that the proportion of roots penetrating the soil is inversely related to the soil penetration resistance.

It was felt that organic farming may solve all these problems and organic farming has been considered as one of the best options for protecting/sustaining soil health, and is gaining lot of importance in present day agriculture. Significant improvements in soil physical, fertility and biological properties have been reported in several organic farming experiments (Surekha *et al.*, 2013) [12]. Under the present situations organic and microbial nutrient sources could be important components of the nutrient management in different agro ecosystems since they are cost-efficient (Das *et al.*, 2014). In addition to supply of nutrients, these organic and microbial inoculants improve the physical condition and biological health of soil, which improves the availability of applied and native nutrients (Meena *et al.*, 2014) [5, 7]. Rose *et al.* (2014) [9] in Vietnam also observed that the biofertilizer can replace between 23 and 52 % of nitrogen (N) fertilizer without loss of yield. So keeping this in view, the present study was undertaken to study the yield, root parameters and grain quality of lowland rice as affected by different nutrient management practices and microbial inoculants.

Materials and methods

A field experiment was conducted during *Kharif* 2016 at the research farm of ICAR Complex for NEH Region (Umiam) Barapani, Meghalaya, situated at 950 m above mean sea level at latitude of 25 41'-21" N and longitude of 91 55'-25 E The soil of the experiment site was sandy clay loam in texture, acidic (5.0) in nature and having low available N (252.98 kg/ha) and P (8.19 kg/ha), but high available K content and soil organic carbon (2.51%) content. The total rainfall during the growing season was 1622.6 mm. The experiment was consisted of 12 treatment combinations and was laid out in split plot design with 3 replications. The treatments were consisted of 3 main plot treatment viz. 100% organic, 100% inorganic (RDF) and INM (75% RDF+ 25% FYM) while in the sub plot there were 4 treatments viz. control, *Azospirillum*, *Azospirillum* + PSB, *Azospirillum* + PSB + ZnSB. The experiment was conducted on 'Shahsarang 1' rice. NPK was applied through urea, single super phosphate and muriate of potash in the ratio of 80:60:40 kg/ha respectively for inorganic nutrient management. While nutrient in organic plot was applied through FYM and through rock phosphate. In INM plots it was applied through 75% RDF and 25% FYM. Biofertilizers were applied as per the recommended concentration and after dissolving in water, roots of the seedlings were dipped in the solution.

Results and discussion

The result showed that root parameters, viz. Root length, root volume and root dry weight were significantly influenced by different nutrient management practices and microbial inoculants (Table 1). The grain yield was recorded to be highest with INM followed by inorganic and organic nutrient management. The highest root volume (51.74 cc), root dry weight (12.59 g) and root length (22.52 cm) were observed in organic nutrient management followed by INM and inorganic treatments. This might be due to the lower bulk density of the soil which poses least resistance to the root growth. Among the treatments with microbial inoculants the highest values of all the three parameters of roots *viz*., root volume (49.20 cc), root dry weight (11.91g) and root length (22.81 cm) were recorded with combined inoculation of *Azospirillum*+ PSB+ ZnSB. The root length with all the three microbial inoculation treatments was significant higher over the control. Kaymak *et al.* (2008) reported that *Azospirillum* sp. might have acted to improve cereals growth by producing growth hormone substances, which ultimately enhanced root growth and root volume in many crops. Charest *et al.* (2005) also reported that *Bacillus subtilis* is capable of maintaining stable contact with plant roots and promote plants growth.

The maximum concentrations of Zn in grain (18.65 ppm) were observed in organic plot and it was significantly higher over INM and inorganic treatment (Table 2). Estrada *et al.* (2013) also reported that rhizobacteria have ability to solubilise Zn in soil because of the mechanism of secretion of organic acids due to the higher activity of these organisms in organic matter rich soils. The highest N concentrations in grain (1.32%) were recorded with inorganic nutrient management practice. Among the microbial inoculants, highest protein content (7.74%) was recorded in *Azospirillum*+ PSB+ ZnSB. Kumar *et al.,* (2014) also reported similar results. Regarding post harvest quality parameters of grain, the highest hulling percentage (68.68%) was recorded in inorganic followed by INM and organic treatment while highest milling (58.81%) and head rice recovery (51.06 %) was recorded in organic followed by inorganic and INM treatment

Table 1: Effect of different nutrient management practices on root parameters of lowland rice in eastern Himalayas.

Treatment	Root volume (cc)	Root dry wt./ plant (g)	Root length (cm)
Nutrient management practices			
Organic*	51.74	12.59	22.52
Inorganic**	40.57	8.43	18.20
INM***	46.11	11.92	20.33
S Em±	1.00	0.16	0.36
CD (P=0.05)	3.90	0.64	1.42
Microbial inoculants			
Control	43.02	10.26	17.50
Azospirillum	45.05	10.45	19.34
Azospirillum+ PSB	47.30	11.30	21.74
Azospirillum+ PSB+ ZnSB	49.20	11.91	22.81
S Em±	0.85	0.32	0.29
CD (P=0.05)	2.51	0.95	0.86
Interaction	NS	NS	NS

* Organic: FYM and rock phosphate;
** Inorganic: 80:60:40 kg/ha N, P_2O_5 & K_2O;
*** INM: 75% Mineral fertilization at RDF (80:60:40 kg/ha) +25% FYM

Table 2: Effect of different nutrient management practices on grain quality of lowland rice in eastern Himalayas.

Treatment	Grain yield (t/ha)	Hulling (%)	N conc. in grain (%)	Zn conc. in grain (ppm)	Protein content (%)	Milling (%)	Head rice recovery (%)
Nutrient management practices							
Organic	3.65	67.34	1.23	18.65	7.07	58.81	51.06
Inorganic	4.08	68.68	1.32	15.92	7.86	55.70	48.65
INM	4.27	67.69	1.30	17.50	7.75	57.58	50.63
S Em±	0.08	0.48	0.017	0.13	0.07	0.28	0.31

CD (P=0.05)	0.34	NS	0.050	0.50	0.27	1.12	1.21
Microbial inoculants							
Control	3.72	67.47	1.26	16.39	7.32	57.09	49.70
Azospirillum	3.94	67.88	1.28	16.77	7.56	57.30	50.12
Azospirillum+ PSB	4.10	68.00	1.29	17.10	7.61	57.53	50.36
Azospirillum+ PSB+ ZnSB	4.25	68.26	1.30	19.16	7.74	57.55	50.68
S Em±	0.05	0.31	0.014	0.14	0.05	0.42	0.37
CD (P=0.05)	0.17	NS	0.03	0.42	0.16	NS	NS
Interaction	S	NS	NS	NS	NS	NS	NS

References

1. Charest MH, Beauchamp CJ, Antoun H. Effects of the humic substances of de- inking paper sludge on the antagonism between two compost bacteria and Pythium ultimum. FEMS Microbiology Ecology, 2005; 52(Suppl 2):219-227.
2. Das A, Patel DP, Munda GC, Ramkrushna GI, Kumar M, Ngachan SV *et al.* Improving productivity, water and energy use efficiency in lowland rice Oryza sativa through appropriate establishment methods and nutrient management practices in the mid-altitude of north-east India. Experimental Agriculture, 2014; 50(3):353-375.
3. Estrada GA, Baldani VLD, de Oliveira DM, Urquiaga S, Baldani JI. Selection of phosphate-solubilizing diazotrophic Herbaspirillum and Burkholderia strains and their effect on rice crop yield and nutrient uptake. Plant and soil, 2013; 369(1-2):115-129.
4. Kaymak HC, Yarali F, Guvenc I, Donmez MF. The effect of inoculation with Plant Growth Promoting Rhizobacteria PGPR on root formation of mint Mentha piperita L Cuttings. African Journal of Biotechnology. 2008; 7(Suppl 24):4479-4483.
5. Kumar A, Meena RN, Yadav L, Gilotia YK. Effect of organic and inorganic sources of nutrient on yield, yield attributes and nutrient uptake of rice cv. PRH-10. The Bioscan. 2014; 9(2):595-597.
6. Martino DL, Shaykewich CF. Root penetration profiles of wheat and barley as affected by soil penetration resistance in field conditions. Canadian Journal of Soil Science. 1994; 74(2):193-200.
7. Meena RK, Singh YV, Lata A, Kumar A, Bana RS. Effect of plant-growth-promoting rhizobacteria inoculation on plant growth, productivity and economics of Basmati rice. Egyptian Journal of Biology. 2014; 16(1):45-50.
8. Osaki M, Shinano T, Matsumoto M, Zheng T, Tadano T. A root-shoot interaction hypothesis for high productivity of field crops. Soil Science and Plant Nutrition. 1997; 43:1079-1084.
9. Rose MT, Phuong TL, Nhan DK, Cong PT, Hien NT, Kennedy IR *et al.* Up to 52% N fertilizer replaced by biofertilizer in lowland rice via farmer participatory research. Agronomy for Sustainable Development. 2014; 34(4):857-868.
10. Sainju UM, Singh BP, Whitehead WF. Tillage, cover crops, and nitrogen fertilization effects on cotton and sorghum root biomass, carbon, and nitrogen. Agronomy Journal. 2005; 97(5):1279-1290.
11. Sattelmacher B, Gerendas J, Thoms K, Brück H, Bagdady NH. Interaction between root growth and mineral nutrition. Environmental and Experimental Botany. 1993; 33(1):63-73.
12. Surekha K, Rao KV, Shobha Rani N, Latha PC, Kumar RM. Evaluation of organic and conventional rice production systems for their productivity, profitability, grain quality and soil health. Agrotechnology, 2013; 1:(S11).
13. Vaid SK, Kumar B, Sharma A, Shukla AK, Srivastava PC. Effect of Zn solubilizing bacteria on growth promotion and Zn nutrition of rice. Journal of soil science and plant nutrition. 2014; 14(4):889-910.