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Research Article

EFFECT OF ORGANIC MANURES AND PGPR ON NUTRIENT CONTENT AND UPTAKE OF MUNGBEAN

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ABSTRACT

Crop rotation and green manure help to provide nitrogen through legumes, which fix nitrogen from the atmosphere through symbiosis with the bacteria *Rhizobium*. Mungbean, being a leguminous crop, has a unique role in fixing atmospheric nitrogen through the process of biological nitrogen fixation (BNF). Rhizosphere micro-organisms such as plant growth promoting rhizobacteria (PGPR) are known to improve BNF. Hence to study the effects of PGPR and organic manures, a field experiment was conducted in the organic farming plot of the Institute of Agricultural Sciences, BHU, Varanasi growing mungbean. The treatments were: Farm yard manure (FYM), Cereal compost, Legume compost along with the combinations of PGPR. It was found that total N, P and K content of the stover were 1.42, 0.34 and 1.74% respectively and that of grain was found to be 3.42, 1.36 and 0.51% respectively on the application of FYM. Co-inoculation with PGPR was found to be more beneficial than non-inoculated manures. FYM+ PGPR treated plots showed highest nutrient content in grains (3.55, 0.55 and 1.41% N, P_2O_5 and K_2O respectively). The combined application of cereal compost and legume compost was effective over their sole application. However, highest protein content (21.91%) was found in the plots receiving all the manures along with co-inoculation of PGPR.

Keywords: Cereal compost, FYM, legume compost, manures, PGPR.

INTRODUCTION

The greatest asset that legumes possess is the biological nitrogen fixation (BNF) which is highly beneficial in the present context of energy crisis. The BNF is known to be more economical and environment friendly. In legumes, VAM fungi increase nodulation and N_2 fixation as a consequence of improved phosphorus nutrition[1]. By this process atmospheric nitrogen is converted into an available form for plants[2]. Mungbean, is versatile having short growing period and easily fits in different cropping patterns[3]. Being a leguminous crop, it has a unique role in fixing atmospheric nitrogen through the process of BNF. Rhizosphere micro-organisms such as plant growth promoting rhizobacteria (PGPR) are known to improve BNF by enhancing the number of nodules and biomass and encourage nitrogenase activity by colonizing root system and suppressing growth of deleterious organisms. This crop inoculation of *Rhizobium* to mungbean enhances nodulation, nitrogen fixation and grain yield. An important feature of the mung bean crop is its ability to establish a symbiotic partnership with specific bacteria, setting up the biological N_2 fixation in root nodules that supplies required nitrogen to the plant[4]. Phytohormone producing microbes enhanced the root mass and length thus enhanced the nutrient concentration in plants[5]. Hence, the present study was undertaken to study the effect of different organic manures and PGPR on the nutrient content of plant and grain of the organically cultivated mungbean.

MATERIALS AND METHODS

The field experiment was conducted at Research farm of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India with mungbean (Malviya-12) in plot size of 3m×4m. The geographical situation of farm lies at $25^0 18'$ North latitude and $80^0 36'$ East longitude and 80.71 meters above mean sea level. Varanasi district comes under agro-ecological region no. 9 (AEZ), which is a hot sub-humid. Manures like FYM, Cereal compost, Legume compost (each @ 5 t ha^{-1}) were applied alongwith PGPR [PGPR: Plant Growth Promoting Rhizobacteria containing *Rhizobium* + *Azotobacter* + *Pseudomonas* + *Trichoderma*]. Three replications of each treatment were maintained in the

experiment. So there were 30 experimental plots along with three control plots (without any organic manure application). Sesbania was applied as a green manure crop before sowing of the crop. The experiment was conducted in Randomized Block Design. *Rhizobium, Azotobacter, Pseudomonas* and *Trichoderma* was prepared by Yeast Extract Mannitol Agar medium method, Ashby's Mannitol Agar medium, Pikovskaya's medium method and potato dextrose agar method respectively. The seeds were treated with these medium for overnight on a day before sowing. The plant and grain samples were collected after flowering and harvesting respectively. Samples were then dried in shade and oven-dried at 105^0 C and after grinding these were analyzed for nutrient content. Total N[6], P and K[7] content of both stover and grain samples were analyzed using the standard procedures. Protein content in mung bean grains was obtained by multiplying the N concentration of grain with a factor 6.25[8]. The soil was Inceptisol (Udic Ustochrept) wit initial pH of 8.82 and organic carbon content of 0.45%.

RESULTS AND DISCUSSION

Effect of treatments on total nitrogen, P and K content of stover and grain

Inoculation with PGPR showed higher amount of N, P and K content as compared to the plants without inoculation. Similar results were also found in legumes after co-inoculation of nodulating forming *Rhizobium* with phosphate solubilizing and growth hormone producing microorganisms[9,10]. Co-inoculation of manures with *Bacillus* and *Rhizobium* demonstrated higher N and P contents in plants might be due to increased nutrient concentration in the rhizosphere of plants, increase in root hair density, more lateral roots, root surface area / nodulation, thus more nitrogen fixation and phosphate solubilization[11]. The favorable effects of inoculation with N_2 to fixing and P to solubilizing microorganisms and significant increase in N_2 to fixation, N per cent and total plant nitrogen of legume crops was also reported[12]. Conjunctive use of *Rhizobium* with PSB and PGPR revealed synergistic effect on the symbiotic parameters and grain yield of mung bean[13]. FYM treated plots showed higher amount of N (1.44%), P_2O_5 (0.37%) and K_2O (1.81%) content as compared to other organic manures. This might be due to high microbial activity as nitrogen is directly related to organic carbon. Nutrient content was next to the application of FYM when all the three manures were applied combinedly. Legume compost treated plants contained higher (1.25% N, 0.29% P_2O_5 and 1.53% K_2O) content than cereal compost treated plots (1.23% N, 0.28% P_2O_5 and 1.49% K_2O). The impact of the microbial solution was greater, when supplied with organic matter with a low C: N ratio. But the combination of cereal compost and legume compost showed higher amount of N in plants than their individual application. Increase in the nutrient concentration in the plants owed to bioavailability of nutrients in the root zone.

It was evident from the table 1 that application of PGPR alongwith manures produced grains of higher nutrient content in comparison to the sole application of manures. Highest N (3.55%), P (0.55%) and K (1.41%) content were found in FYM+ PGPR treated plots followed by the combined application of all the manures. some workers found that N content per gram of grain tissue was significantly enhanced by inoculants[5,14].

Table 1: Total nutrient content of mungbean

Treatments	Total N (%)		Total P (%)		Total K (%)	
	Stover	Grain	Stover	Grain	Stover	Grain
T_1: FYM	1.42	3.42	0.34	0.51	1.74	1.36
T_2: T_1+PGPR	1.44	3.55	0.37	0.55	1.81	1.41
T_3: Cereal Compost	1.23	3.21	0.28	0.44	1.49	1.28
T_4: T_3+PGPR	1.28	3.29	0.29	0.46	1.57	1.31
T_5: Legume Compost	1.25	3.31	0.29	0.45	1.53	1.31
T_6: T_5+PGPR	1.31	3.35	0.29	0.47	1.63	1.32
T_7: Cereal Compost + Legume compost	1.29	3.36	0.30	0.46	1.57	1.33
T_8: T_7+PGPR	1.33	3.38	0.31	0.47	1.58	1.35
T_9: FYM + Cereal Compost + Legume Compost	1.31	3.49	0.32	0.48	1.66	1.34
T_{10}: T_9+PGPR	1.39	3.51	0.33	0.50	1.71	1.38
T_{11}: Control	1.22	3.19	0.27	0.42	1.41	1.25
CD at 5 per cent	0.012	0.012	0.001	0.005	0.011	0.012

Effect of treatments on protein content and plant uptake

It is evident from the table 2 that protein content of grain samples varied from 19.91 to 21.93%. Higher protein content in grains was found in FYM treated plots followed by the combined application of all the manures. Cereal compost treated plots showed lower protein content in comparison to the legume compost treated plots. But the combined application of cereal compost and legume compost produced grains of higher protein content than their sole application. It might be due to higher C:N ratio of cereal compost than legume compost. PGPR treatment proved to be beneficial as it produced grains of higher protein content as compared to the plots without PGPR. Significant increase in seed protein content was observed due to bacterial inoculation supporting the hypothesis that biological nitrogen fixation by the *Rhizobium* and PGPR to root associations could be responsible for the observed higher N uptake of inoculated plants [15,16]. The same trend was followed in nutrient (N, P and K) uptake of the crop. Inoculation significantly increased grain N uptake[17]. Microbial release of nutrients enhanced the nutrient

concentration in soil and hence more uptake by plants. Nitrogen fixing rhizobial nodules increased plant uptake of nitrogen[18]. Plant yield and nutrient (N and P) uptake was significantly increased as a result of inoculation with *Bradyrhizobium* sp. (*Vigna*) and phosphate solubilizing microorganisms (PSM), *Pseudomonas striata*[19]. K concentration and uptake in plants were higher in treatments with *Rhizobium* compared to uninoculated plants.

Table 2: Total uptake and protein content of mungbean

Treatments	Total uptake (kg ha^{-1})			Protein (%)
	N	P	K	
T_1: FYM	72.6	12.7	46.5	21.37
T_2: T_1+PGPR	79.7	14.9	52.4	21.56
T_3: Cereal Compost	48.4	7.9	30.4	20.06
T_4: T_3+PGPR	54.8	9.0	34.5	20.56
T_5: Legume Compost	57.4	9.3	35.7	20.68
T_6: T_5+PGPR	61.0	10.0	38.6	20.93
T_7: Cereal Compost + Legume compost	59.9	9.8	37.4	21.01
T_8: T_7+PGPR	62.6	10.3	38.9	21.12
T_9: FYM + Cereal Compost + Legume Compost	63.3	10.5	39.6	21.81
T_{10}: T_9+PGPR	68.6	11.6	43.2	21.93
T_{11}: Control	47.6	7.4	28.7	19.93
CD at 5 per cent	0.01	0.05	0.09	0.12

CONCLUSION

PGPR application in the organically cultivated plot enhanced the nutrient contents both in the stover and grain. Also the nutrient uptake and grain protein content was increased significantly with application of PGPR. Among the manures, FYM was found to be better than cereal compost and legume compost.

REFERENCES

1. Athar M. Nodulation of native legumes in Pakistani rangelands. Agriculturae Conspectus Scientificus, 2005; 70: 49-54.
2. Ali A, Ali A, Akhtar J and Yaseen M. Effect of phosphorus in combination with rhizobium inoculation on growth and yield parameters of mungbean. Crop Environment, 2010; 1: 53-56.
3. Kumar BS, Prakash M and Gokulakrishnan J. Combining ability analysis in mungbean (Vigna radiata L. Wilczek). Crop Improvement, 2010; 37: 2.
4. Mandal S, Mandal M and Das M. Simulation of indole acetic acid production in Rhizobium isolate of Vigna mungo by root nodule phenolic acids, Archieves of Microbiology, 2009; 191: 389-393.
5. Gull FY, Hafeez I, Saleem M and Malik KA. Phosphorus uptake and growth promotion of chickpea by co-inoculation of mineral phosphate solubilizing bacteria and a mixed rhizobial culture, Austrelian Journal of Experimental Agriculture, 2004; 44:623-628.
6. Jackson MN, Soil chemical analysis, Prentice Hall of India Pvt. Ltd., 1973 New Delhi.
7. Chapman HD and Pratt PF, Methods of analysis for Soils, Plants and Waters, 1961, University of California, Division of Agricultural Sciences.
8. Juliano BO, Polysaccharides, protein and lipids of rice. In: Rice: chemistry and technology. American Association of Cereal Chemists, St. Paul, 1985 p 98.
9. Garcia LJA, Probanza A, Ramos B, Barriuso J and Gutierrez M Effects of inoculation with plant growth promoting rhizobacteria (PGPR) and Sinorhizobium fredii on biological nitrogen fixation, nodulation and growth of *Glycin max* cv. Osumi, Plant Soil, 2004; 267: 143-153.
10. Khan MS, Zaidi A and Wani PA. Role of phosphate solubilizing microorganisms in sustainable agriculture- A review, Agronomy for Sustainable Development, 2006; 26: 1-15.
11. Qureshi MA, Shakir MA, Iqbal A, Akhtar N and Khan A co-inoculation of phosphate solubilizing bacteria and rhizobia for improving growth and yield of mungbean (Vigna radiata L.). Journal of Animal and Plant Sciences, 2011; 21: 491-497.
12. Poonam S, Inderjit S, Veena K, Bains T S and Singh S. Genotypic variability and association studies for growth, symbiotic parameters and grain yield in summer mungbean (Vigna radiata L.). Crop Improvement, 2007; 34: 166-169.
13. Davari M, Sharma SN, Mirzakhani M. Residual influence of organic materials, crop residues, and biofertilizers on performance of succeeding mungbean in an organic rice-based cropping system, International Journal of Recycling of Organic Waste in Agriculture, 2012; 1:14.
14. Adesmoye AO, Torbert HA and Kloepper JW Enhanced plant nutrient use efficiency with PGPR and AMF in an integrated nutrient management system. Canadian Journal of microbiology, 2008; 54: 876-886.

15. Kantar F, Elkoca E, Ogutcu H and Algur OF. Chickpea yields in relation to Rhizobium inoculation from wild chickpea at high altitudes. Journal of Agronomy and Crop Science, 2003; 189: 1-7.
16. Ozturk A, Caglar O and Sahin F. Yield response of wheat and barley to inoculation plant growth promoting rhizobacteria at various levels of nitrogen fertilization. Journal of Plant Nutrition and Soil Science, 2003; 166: 1-5.
17. Delfin E F, Paterno E S, Torres F G and Santos P J A. Biomass, nitrogen uptake and fixed nitrogen partitioning in field grown mungbean (*Vigna radiata* L. Wilcek) inoculated with bradyrhizobium sp. Phillipine Journal of Crop Science, 2008; 33: 24-33.
18. Tokala RK, Strap JL, Jung CM, Crawford DL, Salove MH, Deobald LA, Bailey JF and Morra MJ. Novel plant-microbe rhizosphere interaction involving *Streptomyces lydicus* WYEC108 and the pea plant *Pisum sativum*. Applied and Environmental Microbiology, 2002; 68: 2161–2171.
19. Zaidi A, Saghir Khan and Mohd Aamil. Bioassociative effect of rhizospheric microorganisms on growth, yield and nutrient uptake of greengram. Journal of Plant Nutrition, 2004; 27: 601-612.

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