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EFFECT OF PGPR AND ORGANIC MANURES ON SOIL PROPERTIES OF ORGANICALLY CULTIVATED MUNGBEAN

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ABSTRACT
A field experiment was undertaken in the organic farming plot of the Institute of Agricultural Sciences, BHU, Varanasi with a view to study the effects of manures and PGPR on soil properties. Mungbean (var. Malviya 12) was grown in the plot during *kharif* season of 2009. Organic manures such as Farm yard manure (FYM), Cereal compost, Legume compost and combination of all the manures with or without PGPR [PGPR: Plant Growth Promoting Rhizobacteria containing *Rhizobium* + *Azotobacter* + *Pseudomonas* + *Trichoderma*] was applied @ 5 t ha^{-1} in each plot. It was found that among all the manures tested for cultivation of mungbean, FYM was found to be superior having 320.91, 20.3, 286.72 kg ha^{-1} N, P_2O_5 and K_2O respectively. The combined application of cereal compost and legume compost was effective over their sole application. Application of PGPR was beneficial showing higher nutrient content in soil. The most effective treatment was found to be FYM + PGPR among all the manures showing the highest amount of nutrients of 339.71, 22.33 and 298.66 kg ha^{-1} N, P_2O_5 and K_2O respectively.

INTRODUCTION

The modern system of farming, it is increasingly felt, is becoming unsustainable as evidenced by declining crop productivities, damage to environment, chemical contaminations, etc. The necessity of having an alternative agriculture method which can function in a friendly eco-system while sustaining and increasing the crop productivity is realized now. Organic farming is recognized as the best known alternative to the conventional agriculture. It is a crop production system that avoids the use of synthetic and chemical inputs like fertilizers, pesticides, growth regulators and livestock feed additives. Organic manures such as farmyard manure, compost, vermicompost, biofertilisers, biopesticides, etc. can be used at least as supplement, if not as substitute. Among the components of organic farming, biofertilizers are very important as they are ready to use live formulates of beneficial microorganisms which on application to seed, root or soil mobilize the availability of nutrients by their biological activity in particular and help build up the micro flora and in turn the soil health in general. Parr *et al*., (1994) found that the use of microbial inoculants has obtained much prominence of enhancing the productivity of organic farming systems due to the ability of these organisms to release the bound nutrients in most organic matter at required times for crop utilization. Mungbean, being a leguminous crop, has a unique role in fixing atmospheric nitrogen through the process of biological nitrogen fixation (BNF). Loamy soil is best for its cultivation (Duke, 1981 and Hulse, 1994). The biological nitrogen fixed by mungbean not only meets its own requirement but also leaves nitrogen after harvest, which is beneficial for the next crop. It fixes 31-85 kg N ha^{-1}. Rhizobium/Bradyrhizobium sp., which supplies about 20-40 kg N ha^{-1}, can be considered as a complementary or supplementary source of plant nutrient. The residual organic matter and total nitrogen contents in the soil were positively affected with FYM and inoculation with Rhizobium in legumes (Singh, 2005). Significant with inoculation as compared to control and organic manure was increasing as reported by Negm *et al*. (1998). Hence the present study was undertaken to study the effect of organic manures and different biofertilizers on soil properties with mungbean as the crop.

MATERIALS AND METHODS

The field experiment was conducted at the Research Farm of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi in the organic farming plot. The treatment details were, Farm yard manure (FYM), Cereal compost, Legume compost, combination of all the manures with or without PGPR. [PGPR: Plant Growth Promoting Rhizobacteria containing *Rhizobium* + *Azotobacter* + *Pseudomonas* + *Trichoderma*]. Manures were applied @ 5 t/ha. There were 30 experimental plots along with three control plots (without any organic manure application). The experiment was conducted in Randomized Block Design. Before sowing the seeds in the field, these were treated with PGPR in the laboratory. *Rhizobium, Azotobacter, Pseudomonas* and *Trichoderma* was prepared by Yeast Extract Mannitol Agar medium method,

Ashby's Mannitol Agar medium method, Pikovskaya's medium method and potato dextrose agar method respectively. The seeds were treated with these treatments for overnight on a day before sowing. Soil samples collected after harvesting of the crop were analyzed for pH (Jackson, 1973), EC (Jackson, 1973), organic carbon (Walkley and Black, 1934), available N (Subbiah and Asija, 1956), P (Olsen *et al*., 1954), K (Hanway and Heidel, 1952) and S (Chesnin & Yien, 1950) in the Soil Chemistry Laboratory of the Department of Soil Science and Agricultural Chemistry, IAS, BHU.

RESULTS AND DISCUSSION

Effect of treatments on pH and EC of soil samples

The value of pH and EC varied between 8.11 to 8.34 and 0.102 to 0.117 dS/m respectively. FYM treated soils showed lower pH and EC followed by the cereal compost treated soils without PGPR. This decrease might be due to the production of organic acids during decomposition of FYM in soil. Effects of all the manures were found to be significant over control.

Cereal compost + PGPR showed highest pH (8.34) in soil among all the applications followed by the combined application of all the manures with PGPR. Among the manures application with PGPR, FYM + PGPR showed lowest pH and EC due to secretion of organic acids during decomposition of FYM. Legume compost + PGPR also showed comparatively lesser pH and higher EC than cereal compost+ PGPR. The drop in pH may be attributed to the effect of inoculants on rate of organic matter degradation. Some workers reported that release of organic acids with application of PGPR decreases pH of soil sample.

Effect of PGPR on organic carbon of soil sample

Organic carbon content of soils varied from 0.48 to 0.75. Lokanath *et al.,* (2004) found that in groundnut the initial soil test values showed 0.56 per cent organic carbon. It was evident from the table that FYM treated plots showed higher organic carbon content (0.72) than other manures without PGPR. This is in accordance with the result of Yadav *et al.,* (2009) who reported that FYM application increases organic carbon content in soil. Lowest organic carbon was found in cereal compost treated soils. Organic carbon was higher in legume compost treated soils. Combination of both of the above manures produced higher organic carbon in soil than their sole application. Combined application of all the manures showed higher organic carbon in soil and the value was next to FYM application. All the manures were significant in their effect over control. According to Rajendra Prasad (2005), continued use of organic manure on a farm improves its organic matter content, which supports the soil micro, meso and macro fauna and makes the soil a living body.

Manure application with PGPR showed higher organic carbon in soil as compared to the sole application of manures. FYM + PGPR treated soils showed highest organic carbon in soil. Almost similar to this were the organic carbon content produced by combined application of all the manures with PGPR. It was followed by the legume compost + PGPR treated soils showing comparatively higher organic carbon content in soils in comparison to the application of cereal compost + PGPR.

Effect of treatments on available N, P and K content of soil

Available nitrogen content in soil varied from 285.38 to 339.73 kg ha^{-1} and was in medium range. The values of P content varied between 16.36 to 22.33 kg ha^{-1} and were in medium range. It was observed that K content in soil samples varied between 226.98 to 298.66 kg ha^{-1} i.e. in medium to high range. Lokanath *et al.,* (2004) found that in groundnut the initial soil test values were 270.61 kg available N ha^{-1}, 40.85 kg available P_2O_5 ha^{-1}, 436.67 kg available K_2O ha^{-1}, with 7.7 pH. Higher available nitrogen, P and K was found in FYM treated plots followed by the combined application of all the manures without PGPR. Ramesh *et al.,* (2006) found that the soil organic carbon, available N and K were higher in cattle dung manure treatment. Legume compost treated soils contained higher N, P and K content in comparison to the cereal compost treated soils. Sangakkara (1999) reported that the impact of the microbial solution was greater, when supplied with organic matter with a low C: N ratio. But the combined application of cereal compost and legume compost showed higher nutrient content in soils in comparison to their sole application. But the effects of all the manures were found to be significant over control.

PGPR application alongwith manures were found to be beneficial over sole application of manures. Combined application of all the manures alongwith PGPR followed the

Table 1: Effect of organic manures and PGPR on some soil properties

Treatments	pH	EC (dS/m)	Organic C (%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	Available S (kg ha^{-1})
T_1: FYM	8.11	0.102	0.72	320.91	20.3	286.72	32.44
T_2: T_1 + PGPR	8.13	0.104	0.75	339.73	22.33	298.66	35.98
T_3: Cereal Compost	8.21	0.103	0.53	289.55	17.16	237.62	23.48
T_4: T_3 + PGPR	8.34	0.105	0.56	294.78	18.4	244.4	24.24
T_5: Legume Compost	8.22	0.104	0.57	292.69	17.73	247.33	25.25
T_6: T_5 + PGPR	8.25	0.106	0.6	298.96	18.63	253.53	26.01
T_7: Cereal Compost + Legume compost	8.12	0.107	0.61	300.01	18.2	254.4	27.27
T_8: T_7 + PGPR	8.16	0.109	0.64	306.28	19.06	261.97	28.40
T_9: FYM + Cereal Compost + Legume Compost	8.27	0.110	0.70	309.41	18.73	272.12	29.16
T_{10}: T_9 + PGPR	8.28	0.112	0.75	317.78	19.36	279.36	30.93
T_{11}: Control	8.17	0.113	0.48	285.38	16.36	226.98	22.85
SEm ±	0.010	0.0006	0.010	1.38	0.07	1.12	0.36
CD at 5%	0.022	0.0013	0.021	2.88	0.16	2.34	0.76

above treatments. All the manures with PGPR showed higher N, P and K content in soils in comparison to the application of manures without PGPR. But the effects of all the treatments were found to be significant over control. Thus, application of PGPR alongwith manures was superior over sole application of manures. Similar results were found when Singh and Subba Rao (1979) who found that PSB increased the available P content of the soil. Also Prasad and Chandra (2003) and Gunasekaran *et al.,* (2004) found that PSB also increased the available P content of the soil. Kucey *et al*., (1989) showed that Phosphorus biofertilizers could help increase the availability of phosphates accumulated in the soil and could enhance plant growth by increasing the efficiency of biological nitrogen fixation. Shinde *et al.,* (2008) reported that upon application of PGPR, the available nitrogen, phosphate and potash were increased from 199.0 to 282.0, 14.77 to 27.52 and 366.7 to 448.75 kg ha^{-1} respectively.

Effect of treatments on available sulphur content of soil

S content of soils varied between 22.85 to 35.98 mg kg^{-1} (ppm) i.e. in medium to high range. Soils treated with FYM had higher S content than other manures followed by the combined application of all the manures. Cereal compost showed lesser S content in comparison to the legume compost treated soils. Sangakkara (1999) reported that the impact of the microbial solution was greater, when supplied with organic matter with a low C: N ratio. But the combined application of cereal compost and legume compost was found to be superior over their individual application. Effects of all the manures were significant over control.

Application of PGPR alongwith manures was found to be beneficial showing higher S content in soils. FYM+ PGPR showed highest S content in soils. Combination of cereal compost and legume compost+ PGPR was found to be beneficial over application of cereal compost+ PGPR and legume compost+ PGPR. But the S content in combined application of all the manures alongwith PGPR was next to FYM+ PGPR. Effects of all the manures with or without PGPR were found to be significant over control.

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