Int.J.Curr.Microbiol.App.Sci (2017) *6*(5): 2287-2292

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 5 (2017) pp. 2287-2292**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.605.255

Effect of Rice Husk Biochar, Carpet Waste, FYM and PGPR on Chemical Properties of Soil

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A B S T R A C T

The present investigation was aimed for improving growth and yield of crop using waste products of different activities and also useful in ecological stability of soil environment. The experiment was conducted in the organic farming plot of the Institute of Agricultural Sciences, BHU, Varanasi during kharif season of mungbean crop (*Vigna radiata* L.) in 2014. The field experiment was laid out in Randomized Block Design with 10 treatments and three replications. Application of graded level of biochar, carpet waste FYM and PGPR was found to significantly enhance the straw and grain yield of mungbean. Application of BC2, CW1 FYM1 and PGPR was found 60.17% higher over the treatment T1 (control).Grain and straw yield of mungbean significantly increased with the application of graded level BC, CW, FYM and PGPR. The available nitrogen content of soil ranged between 283.55 and 323.66kg ha-1, the minimum being in control (T1) and maximum in treatment T10 (BC2+ CW1+ FYM1 t ha-1+PGPR). Application BC in the soil resulted in increase soil EC, pH, OC but the increase was not significant. No interaction effects among BC, CW and PGPR were found to be non-significant in influencing the available phosphorus and potassium content of soil.

Keywords

Rice Husk Biochar, Carpet waste, FYM and PGPR mungbean

Article Info

Accepted:
25 April 2017
Available Online:
10 May 2017

Introduction

Mungbean (*Vigna radiata* L. Wilezek) is the third most important pulse crop cultivated in India covering an area of 2.39 m ha, with production of 0.89 million tones and an average productivity of 498 kg ha^{-1} (Anonymous, 2015). It is estimated that Indian population will be around 1350 million by 2020 and demand for pulses would further grow in the years to come. The production of pulse crops in India in general and especially mungbean is not enough to meet the domestic demand of the ever growing population. Hence, there is need to enhance the productivity of mungbean by adopting proper nutrient management using organic manure like rice husk biochar, carpet waste, farm yard manure and PGPR apart from evolving new high yielding varieties.

Biochar is a carbon rich solid product obtained after heating biomass, such as wood, manure or leaves under limited supply or absence of oxygen (Lehmann and Joseph, 2009). In the recent years, biochar is gaining importance as a good source of amendment because it helps in stabilizing photosynthetic carbon. Biochar is relatively low density material that helps in lowering the bulk density of high clay soil along with increasing aeration and root penetration. Also, it increases the ability of sandy soils to retain water and nutrients. Biochar application work as liming agents because it helps to the offset of the acidifying effect of nitrogen fertilizers, thereby, reducing the need for further liming. Carpet waste is source of multi nutrient to supply the adequate amount of nutrient. It contents higher amount of nitrogen but phosphorus and potassium have very less amount.

Much of the effects of FYM on soil and crop yield are due to its high humus content, which serves as a slow release of plant nutrient. The efficiency of FYM can be increased by the addition of phosphate fertilizers. (Basir *et al,* 2008).

Plant growth promoting rhizobacteria (PGPR) represent a wide range of soil bacteria which, when applied in association with a host plant, result in stimulation of plant growth of their host plant (Vessey, 2003). Inoculating planting material with PGPR presumably prevents or reduces the establishment of pathogens.

So waste products like biochar, Carpet waste and FYM become important for improving crop growth and yield which need evaluation. These discoveries will open new avenues and enhance our understanding which economically solution of limited crop production in different types of soil.

Materials and Methods

The experiment was carried out at the Organic farming plot of the Institute of Agricultural Sciences, BHU, Varanasi. Three replications of each treatment were maintained in the experiment. So there were 27 experimental plots along with three control plots (without any treatment). The experiment was conducted in Randomized Block Design. To determine the initial physico-chemical properties of soil representative soil samples were collected from five different places before conducting the experiment from the depth of 0-20 cm in sandy clay loam texture soil with pH value of 7.42, EC- 0.170 dSm-1and organic carbon 0.45%. The initial soil was low in available N (258.55 kg ha-1), medium in available P (14.27 kg ha-1) and medium in available K (223.45 kg ha-1). Pre-Prepared Biochar was collected from Shree ram rice mill jasuri, Chandauli, Uttar Pradesh in the month of June 2014.

Results and Discussion

Effect treatment on some selected post-harvest soil properties

Soil reaction (pH)

The application of BC and CW in soil failed to show any significant influence on soil pH over control. Application BC in the soil resulted in increase soil pH, but the increase was not significant. This indicates that the application of high dose of BC case an increase in soil pH. The inoculation with PGPR has been resulted non significantly lower pH as compared to without PGPR. This might be due to the organic acids produced by PGPR. None of interaction effect was found to be significant among BC, CW, FYM and PGPR in altering the soil pH. Carter *et al.*, (2013) reported that use of rice husk biochar increased the mean pH both fertilized and non-fertilized soil but was non significant.

Electrical conductivity (EC)

Data pertaining EC of soil has been presented in Table 2 representing that no significant increase in the EC of soil with application of biochar, carpet waste, FYM and PGPR was observed. It is evident that the EC of soil ranged between 0.197 to 0.237 dSm-1. The minimum value of EC (0.197dSm-1) was recorded in control (T1) and maximum (0.237 dSm-1) in treatment T10 (BC2+ CW1+ FYM1 t ha-1+PGPR).

Organic carbon

From the data presented in table 2, no significant effect of biochar, carpet waste on soil organic carbon content. Application of biochar and carpet waste increase in soil organic carbon content, but the increase was statistically non significant. The minimum organic carbon content (0.48) was observed in control (T1) and T6(PGPR).The maximum organic carbon content (0.61) was observed in T5(BC2+ CW1 + FYM1 t ha-1). The inoculation of PGPR decreases the organic carbon content in the soil because the rate of decomposition of organic matter is increased.

Available nitrogen

A perusal of table 2 indicated that the available nitrogen content of post-harvest soil was increased with increase in application of biochar, carpet waste and FYM with PGPR. The available nitrogen content of soil ranged between 283.55 and 323.66kg ha-1, the minimum being in control (T1) and maximum in treatment T10 (BC2+ CW1+ FYM1 t ha-1+PGPR) followed by treatment T9 (BC1+ CW1+ FYM1 t ha-1+PGPR). The treatment T10 was 3.54% higher over Treatment T5 (BC2+ CW1+ FYM1 t ha-1), treatment T6 was 2.11% higher over Treatment T1(control).However, the treatments T2 (BC1+ CW1 t ha-1), T3 (BC2+ CW1 t ha-1) and T9 (BC1+ CW1+ FYM1 t ha-1+PGPR), T10 (BC2+ CW1+ FYM1 t ha-1+PGPR) were found statically at par to each other. Mann and Ashraf (2000) reported that organic manures increased soil organic matter content and thus total nitrogen.

Table.1 Effect of biochar, carpet waste, FYM and PGPR consortium grain and straw yield of mungbean in kharif season 2014

Treatment		Grain yield q ha^{-1}	straw yield q ha^{-1}
T_1	Control	9.09	40.00
T_2	BC_1+ CW_1 t ha^{-1}	9.72	44.33
T_3	BC_2+ CW_1 t ha^{-1}	9.94	46.67
T_4	BC_1+ CW_1 + FYM_1 t ha^{-1}	10.53	54.44
T_5	BC_2+ CW_1 + FYM_1 t ha^{-1}	10.83	56.78
T_6	PGPR	10.58	45.00
T_7	BC_1+ CW_1 t ha^{-1} + PGPR	11.19	48.70
T_8	BC_2+ CW_1 t ha^{-1} + PGPR	12.19	51.45
T_9	BC_1+ CW_1 + FYM_1 t ha^{-1} + PGPR	14.14	58.81
T_{10}	BC_2+ CW_1 + FYM_1 t ha^{-1} + PGPR	14.56	61.94
SEm±		0.552	1.484
CD at 5%		1.597	4.293

Table.2 Effect of biochar, carpet waste, FYM, and PGPR consortium on physicochemical properties of soil after harvesting of mungbean during kharif season 2014

	Treatments	pH	EC (dSm-1	OC (%)	**N**	**P**	**K**
T_1	Control	7.37	0.197	0.48	283.55	16.43	226.79
T_2	BC_1+ CW_1 t ha^{-1}	7.43	0.240	0.52	288.70	17.70	229.46
T_3	BC_2+ CW_1 t ha^{-1}	7.50	0.256	0.58	292.52	18.27	232.29
T_4	BC_1+ CW_1 + FYM_1 t ha^{-1}	7.33	0.212	0.54	307.61	19.81	240.32
T_5	BC_2+ CW_1 + FYM_1 t ha^{-1}	7.37	0.225	0.61	312.58	20.77	243.44
T_6	PGPR	7.53	0.177	0.48	289.55	17.62	228.88
T_7	BC_1+ CW_1 t ha^{-1} + PGPR	7.60	0.252	0.50	295.81	18.67	232.21
T_8	BC_2+ CW_1 t ha^{-1} + PGPR	7.67	0.264	0.56	298.78	19.08	233.89
T_9	BC_1+ CW_1 + FYM_1 t ha^{-1} + PGPR	7.43	0.225	0.57	316.49	21.04	242.84
T_{10}	BC_2+ CW_1 + FYM_1 t ha^{-1} + PGPR	7.50	0.237	0.60	323.66	22.21	244.19
	SEm±	0.129	0.009	0.035	6.290	1.913	6.794
	CD at 5%	NS	NS	NS	18.194	NS	NS

Details of treatments followed in the plot

Treatments	**Details of treatments**
T_1	Control
T_2	Biochar + carpet waste (1+1 t) ha^{-1}
T_3	Biochar + carpet waste (2+1 t) ha^{-1}
T_4	Biochar + carpet waste+ FYM (1+1+1 t) ha^{-1}
T_5	Biochar + carpet waste + FYM (2+1+1 t) ha^{-1}
T_6	PGPR
T_7	Biochar + carpet waste (1+1 t) ha^{-1}+ PGPR
T_8	Biochar + carpet waste (2+1 t) ha^{-1}+ PGPR
T_9	Biochar + carpet waste+ FYM (1+1+1 t) ha^{-1} + PGPR
T_{10}	Biochar + carpet waste + FYM (2+1+1 t) ha^{-1}+ PGPR

BC (Biochar), CW (Carpet Waste), PGPR: Plant Growth Promoting Rhizobacteria (*Rhizobiutn* + *Azotobacterchroococcum* HUAZ-1 +*Pseudomonas fluoreseans* BHUPSB-06 + *Paenibacilluspolymyxa* BHUPSB-16)

Available phosphorus

Data presented in table 2indicate that the application of biochar, carpet waste was statistically non significant over treatment T1 (control). Application of BC was found to be non significant on the available phosphorus content in soil, similar result were also reported by Rondan *et al.,* (2007). The inoculation with PGPR increased the available phosphorus in soil by 14.1% over without PGPR. Mittal *et al.,* (2008) reported that application of PGPR in chick pea can increase available phosphorus after the harvest of crop up to 26%. No interaction effects among BC, CW and PGPR were found to be significant in influencing the available phosphorus content of soil.

Available potassium

From the data presented in table 2, no significant effect of biochar, carpet waste on the available potassium of the soil was noticed. Application of biochar and carpet waste increase the available potassium content of soil, but the increase was statistically non significant. Similar result was also reported by Rondan *et al.,* (2007). The inoculation with PGPR increased the available potassium in soil but the difference was statistically non significant. None of the interaction effect was found to be significant among control, BC, CW, FYM and PGPR in altering the available potassium content of soil. Sudarso (2010) identified that the highest CEC, P and K were observed in soil treated with rice husk biochar, but did not significantly.

It is concluded that the application of graded level of biochar, carpet waste FYM and PGPR was found to significantly effective to enhance the grain and straw yield of rice. Application of BC2, CW1 FYM1 and PGPR was found 60.17% higher grain and straw yield by 54.85 % over the treatment T1 (control). Nitrogen content of post-harvest soil was increased with increase level of biochar, carpet waste and FYM with PGPR. Application of BC was found to be no significant on the available phosphorus content in soil. Biochar and carpet waste increase the available potassium content of soil, but the increase was statistically non significant. Soil pH and electrical conductivity did not show any significant change with use of carpet waste, FYM and PGPR with graded levels of biochar.

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How to cite this article:

Shiv Singh Meena, D.C. Kala, Praveen Solanki and Vinod Sarode. 2017. Effect of rice husk biochar, carpet waste, FYM and PGPR on chemical properties of soil. *Int.J.Curr.Microbiol.App.Sci.* 6(5): 2287-2292.
doi: https://doi.org/10.20546/ijcmas.2017.605.255