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CONJUGATED EFFECT OF COMPOSTED COIRPITH, COMPOSTED PRESSMUD, FARMYARD MANURE AND NPK ON SOIL ENZYME ACTIVITIES AND NUTRIENT STATUS OF POST HARVESTED SOIL OF CLUSTERBEAN *CYAMOPSIS TETRAGONOLOBA* L. (TAUB) VAR. PUSA NAVBAHAR)

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ABSTRACT

A field experiment was conducted to study the effect of composted coirpith, composted pressmud, farmyard manure and NPK on soil enzyme activities and nutrient status of post harvested soil of clusterbean. The experiment consisting of twelve treatments (T_1- Control,T_2- Composted coirpith (12.5t ha $^{-1}$, T_3- Composted pressmud (12.5t ha^{-1}), T_4- Farmyard manure (12.5t ha^{-1}), T_5- NPK (100%), T_6- Composted coirpith (12.5t ha^{-1}) + 50% NPK, T_7- Composted pressmud (12.5t ha^{-1}) + 50% NPK, T_8- Farmyard manure (12.5t ha^{-1}) + 50% NPK, T_9- Composted coirpith (12.5t ha^{-1}) + 25% NPK, T_{10}- Composted pressmud (12.5t ha^{-1}) + 25% NPK, T_{11}- Farmyard manure (12.5t ha^{-1}) + 25 % NPK, T_{12}- Composted coirpith (6.5t ha^{-1}) + Composted pressmud (6.5t ha^{-1}) + Farmyard manure (6.5t ha^{-1}) was laid in a pot having 7kg soil (per pot) with three replications. Dehydrogenase and the urease enzyme activity of the soil with different treatments used for the productivity of cluster bean was high in all the treatments but the maximum was found in T_{12} (Composted coirpith (6.5t ha^{-1}) + Composted pressmud (6.5t ha^{-1}) + Farmyard manure (6.5t ha^{-1}) followed by T_9 (Composted coirpith (12.5t ha^{-1}) + 25% NPK) when compared to the control T_1. pH of the post harvest soil of cluster bean was maximum in T_8 (Farmyard manure (12.5t ha^{-1}) + 50% NPK), while all other nutrients (electrical conductivity (millimhos cm^{-1}), organic carbon (%), available nitrogen (Kg ha^{-1}), available phosphorus (Kg ha^{-1}), available potassium (Kg ha^{-1}), sulphur (ppm) and available micronutrients (copper (ppm), zinc (ppm), iron (ppm) and manganese (ppm)) were maximum in T_{12}(Composted coirpith (6.5t ha^{-1}) + Composted pressmud (6.5t ha^{-1}) + Farmyard manure (6.5t ha^{-1}) when compared to the control T_1 in post harvest soil of cluster bean.

INTRODUCTION

Agroindustrial wastes and byproducts are renewable forms of resources generated all over the world. Composting of organic materials from the solid waste not only provides a valuable benefit to nutrient deficient soil, but also include the increase in beneficial soil organisms, the suppression of certain plant diseases, the reduced need for fertilizers and pesticides, prevention of soil erosion and nutrient run-off and assistance in land reclamation projects. The agricultural use of composted coirpith, composted pressmud and farmyard manure for agricultural purposes implicates the knowledge of its characteristics, mainly alkalinity, salinity and organic matter content after composting and the effects of these characteristics on soil properties, mainly after successive amendments. Microorganisms produce extracellular enzymes (ligninase and cellulases) to degrade lignin lignocelluloses in plant biomass. Coir wastes after biodegradation can be effectively used as manure for increasing yield of crops. Pressmud, an end product of the sugar factory which is used as one of the substrate in biocomposting. Depending on the quality of cane and the extraneous matter that comes with sugarcane, pressmud is about 3.5% to 4.5% of the total cane crushed. The composition of raw pressmud includes carbon, nitrogen, phosphorous, potash, calcium, magnesium, copper, zinc, manganese, iron, silicon and wax. Farmyard manure is an organic manure which is a mixture of cow dung, cow urine, straw wastes etc. Maintaining and improving the soil in the

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long run is an essential part of sustaining the ecosystem. Cluster bean (*Cyamopsis tetragonoloba* (L.) Taub) is an annual legume widely cultivated in countries like India, Pakistan, USA etc. Cluster bean is a drought tolerant crop used as vegetable as well as nutritious fodder for livestock. Use of agroindustrial wastes such as coirpith, pressmud, farmyard manure improves the water holding capacity of the soil. Soil fertility is diminishing gradually due to the erosion, loss of nutrients, accumulation of salts and other toxic elements and unbalanced nutrients compensation. Many efforts are being exercised to combat the adverse consequences of chemical farming (Krishnakumar *et al*., 2005).

The present study was, for such motives, undertaken with the objective to find out and determine the effect of composted coirpith, composted pressmud , farmyard manure and NPK on soil enzymatic activities and nutrient status of post harvested soil of cluster bean.

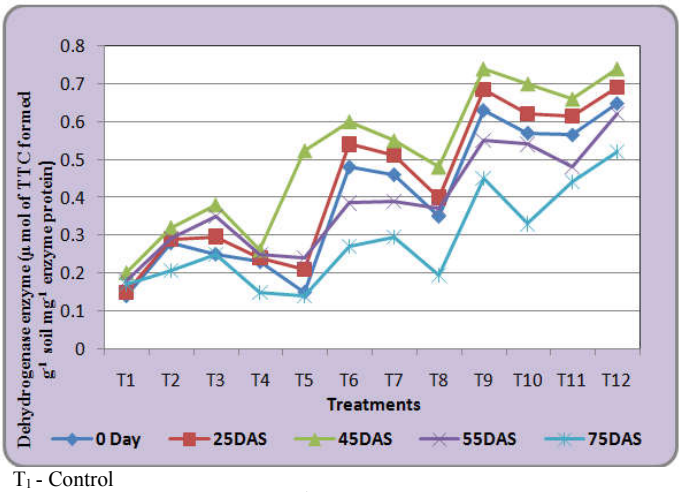
MATERIALS AND METHODS

The agroindustrial waste such as pressmud was collected from Bannari Sugars Private limited Sathyamangalam and coirpith from Pollachi, Tamil Nadu (India). Seeds of cluster bean and FYM were collected from Tamil Nadu Agricultural University, Coimbatore. Using *Pleurotus sajor caju* the compost was prepared. The pots were filled with 7kg of sandy clay loam soil. The composts was applied to the respective pots and mixed thoroughly. Viable seeds were selected and about five seeds were sown in each pot with three replications. After germination three healthy plants were maintained per pot. In this experiment composted coirpith, composted pressmud and FYM were incorporated in different concentration-T1- Control, T2- Composted coirpith (12.5t ha -1), T3- Composted pressmud (12.5t ha-1), T4- Farmyard manure (12.5t ha-1), T5- NPK(100%), T6- Composted coirpith (12.5t ha-1) + 50% NPK, T7- Composted pressmud (12.5t ha-1) + 50% NPK, T8- Farmyard manure (12.5t ha-1) + 50% NPK, T9- Composted coirpith (12.5t ha-1) + 25% NPK, T10- Composted pressmud (12.5t ha-1) + 25% NPK, T11- Farmyard manure (12.5t ha-1) + 25 % NPK, T12- Composted coirpith (6.5t ha-1) + Composted pressmud (6.5t ha-1) + Farmyard manure (6.5t ha-1). On 0day, 25, 45, 55 and 75 DAS dehydrogenase and urease enzyme activity of the soil for the productivity and nutrient status of post harvested soil of cluster bean was analysed.

RESULTS AND DISCUSSION

Effect of composted coirpith, composted pressmud and farmyard manure on the dehydrogenase enzyme activity of the soil used for the productivity of cluster bean

It can be inferred from Figure- I a maximum dehydrogenase activity upto 45 DAS and after that, it declined gradually in all the treatments. The soil dehydrogenase activity increased maximally in T_{12} (composted coirpith (6.5t ha^{-1}) + composted pressmud (6.5t ha^{-1}) + farmyard manure (6.5t ha^{-1})) from 0.648 to 0.740 µ mol of TTC formed gm^{-1} soil mg^{-1} enzyme protein followed by T_9 (composted coirpith(12.5t ha^{-1}) + 25% NPK) treatment from 0.630 to 0.740 µ mol of TTC formed gm^{-1} soil mg^{-1} enzyme protein and decreased gradually to 0.520 µ mol of TTC formed gm^{-1} soil mg^{-1} enzyme protein and 0.450 µ mol of TTC formed gm^{-1} soil mg^{-1} enzyme protein at harvest as compared to control T_1 (increased from 0.140 to 0.200 up to 45 DAS and decreased to 0.170µ mol of TTC formed gm^{-1} soil mg^{-1} enzyme protein at harvest).



T_1 - Control
T_2 - Composted coirpith (12.5t ha^{-1})
T_3 - Composted pressmud (12.5t ha^{-1})
T_4 - Farmyard manure (12.5t ha^{-1})
T_5 - NPK (100%)
T_6 - Composted coirpith (12.5t ha^{-1}) + 50% NPK
T_7 - Composted pressmud (12.5t ha^{-1}) + 50% NPK
T_8 - Farmyard manure (12.5t ha^{-1}) + 50% NPK
T_9 - Composted coirpith (12.5t ha^{-1}) + 25% NPK
T_{10} - Composted pressmud (12.5t ha^{-1}) + 25% NPK
T_{11} - Farmyard manure (12.5t ha^{-1}) + 25 % NPK
T_{12} - Composted coirpith (6.5t ha^{-1}) + Composted pressmud (6.5t ha^{-1}) + Farmyard manure (6.5t ha^{-1})

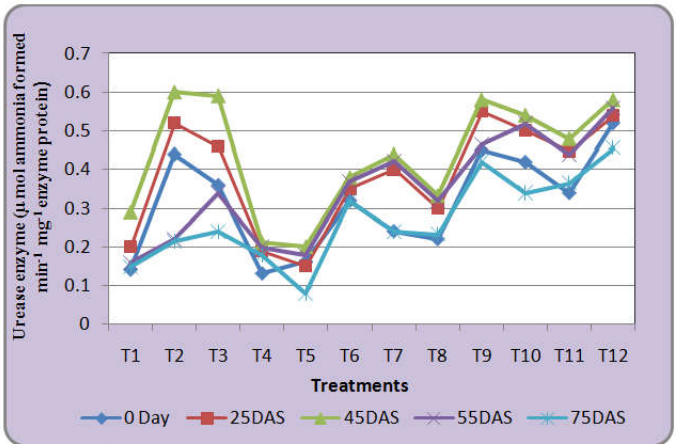
Figure 1. Dehydrogenase enzyme activity of the soil with different treatments used for the productivity of cluster bean

The result is on par with Vajantha *et al*. (2010) who observed a maximum increase in dehydrogenase activity of 35.23 µg TPF/ nitrophenol/gm soil/ h with the application of 100% nitrogen through poultry manure to maize crop. The increase in soil dehydrogenase enzyme activity up to 45 DAS might be due to the increased population of microorganism like bacteria etc., due to the increased availability of substrate (organic carbon) through composted coirpith, composted pressmud and farmyard manure which in turn release this enzyme of extra-cellular origin and declined after that which might be due to the lack of sufficient substrate (organic carbon) which act as energy source for proliferating the microbial population.

Effect of composted coirpith, composted pressmud and farmyard manure on the urease activity of the soil used for the productivity of cluster bean

Urease enzyme is an important extracellular enzyme which influences the availability of plant utilizable forms of nitrogen in soil. As shown in Figure – II it was revealed that there was a substantial increase in soil urease enzyme activity up to 45 DAS and after that, it declined gradually in all the treatments. Among the treatments a significant increase in urease activity up to 45 DAS was recorded in T_{12} (composted coirpith (6.5t ha^{-1}) + composted pressmud (6.5t ha^{-1}) + farmyard manure (6.5t ha^{-1})) from 0.520 to 0.600 µ mol ammonia formed min^{-1}

mg^{-1} enzyme protein followed by T_9 (composted coirpith (12.5t ha^{-1}) + 25% NPK) from 0.450 to 0.580 µ mol ammonia formed min^{-1} mg^{-1} enzyme protein and the enzyme activity gradually declined to 0.457 and 0.420 µ mol ammonia formed min^{-1} mg^{-1} enzyme protein over 75 DAS of degradation when compared to control T_1 (increased from 0.140 to 0.290 up to 45 DAS and decreased to 0.150 µ mol ammonia formed min^{-1} mg^{-1} enzyme protein at harvest).



T_1 - Control
T_2 - Composted coirpith (12.5t ha^{-1})
T_3 - Composted pressmud (12.5t ha^{-1})
T_4 - Farmyard manure (12.5t ha^{-1})
T_5 - NPK (100%)
T_6 - Composted coirpith (12.5t ha^{-1}) + 50% NPK
T_7 - Composted pressmud (12.5t ha^{-1}) + 50% NPK
T_8 - Farmyard manure (12.5t ha^{-1}) + 50% NPK
T_9 - Composted coirpith (12.5t ha^{-1}) + 25% NPK
T_{10} - Composted pressmud (12.5t ha^{-1}) + 25% NPK
T_{11} - Farmyard manure (12.5t ha^{-1}) + 25 % NPK
T_{12} - Composted coirpith (6.5t ha^{-1}) + Composted pressmud (6.5t ha^{-1}) + Farmyard manure (6.5t ha^{-1})

Figure- 2. Urease enzyme activity of the soil with different treatments used for the productivity of cluster bean

The present observation is on par with the result of Usha Rani *et al*. (2013) who also observed an increase in urease activity with the application of 100% vermicompost at different growth stage of maize (30.82 mg NH_4^+ formed gm^{-1} of soil h^{-1}) and at final cutting of spinach (17.66 mg NH_4^+ formed g^{-1} of soil h^{-1}) in maize- spinach cropping system when compared to control (20.34 mg NH_4^+ formed gm^{-1} of soil h^{-1} and 10.05 mg NH_4^+ formed gm^{-1} of soil h^{-1}). The urease activity increased significantly with increase in nitrogen level. This was evidently due to higher availability of substrate nitrogen (composted coirpith, composted pressmud and farmyard manure) which promoted urease enzyme. Decrease in urease activity in harvest stage might be due to its utilization by the plants or microorganisms.

Post harvest nutrient status in soil of cluster bean (TABLE- 1)

pH

pH was found to be highest in T_8 (7.49) treatment followed by T_{12} (7.46) treatment when compared to control T_1 (6.05). (Table- I)This result coincides with the result of Ahmad *et al*. (2012) who also reported increase in pH of 8.00 with the addition of pressmud in conventional media (garden soil+ silt+ leaf mould [1:1:1:, v/v/v]) when compared to conventional media alone (control) of 7.8. The increase in pH when applied with organic materials can be attributed to ligand exchange reaction releasing OH ions causing an increase in pH.

EC and organic carbon

The maximum EC and organic carbon was estimated in T_{12} (5.99 millimhos/cm and 2.03%) followed by T_9 (5.94 millimhos/cm and 2.00%) when compared to control T_1 (1.54 millimhos/cm and 0.15%). The result is on par with the result of Singh and Aggarwal (2000) who reported increase

Table 1. Post harvest soil analysis of cluster bean (*Cyamopsis tetragonoloba* l. (taub) var. Pusa navbahar)

Treatment	pH	EC (millimhos cm^{-1})	Organic carbon (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)	Sulphur (ppm)	Copper (ppm)	Zinc (ppm)	Iron (ppm)	Manganese (ppm)
T_1	6.05	1.54	0.15	60	5.54	307	18.09	2.00	0.91	4.38	4.22
T_2	6.27	2.90	0.20	76	9.04	377	30.00	1.19	2.71	4.80	4.53
T_3	6.38	2.54	0.23	83	12.09	418	43.03	1.22	1.90	5.66	5.34
T_4	6.78	2.64	0.19	76	8.04	319	35.06	1.82	2.81	5.78	5.46
T_5	6.50	2.04	0.17	63	5.59	310	19.06	1.14	1.49	4.45	4.49
T_6	6.68	3.03	0.23	82	6.04	373	40.12	1.80	1.60	4.76	5.83
T_7	6.02	5.00	1.59	85	9.06	314	35.10	1.59	1.73	5.82	6.55
T_8	7.49	3.97	1.64	74	9.54	328	34.04	1.64	1.64	6.63	6.88
T_9	7.12	5.94	2.00	90	13.00	431	64.10	2.02	2.90	7.60	8.01
T_{10}	7.43	3.04	1.22	74	8.04	370	35.04	1.22	1.74	6.33	6.46
T_{11}	7.33	4.87	1.28	71	8.59	368	32.10	1.28	1.73	6.73	7.97
T_{12}	7.46	5.99	2.03	95	13.09	445	68.12	2.05	2.93	7.80	8.39

T1 - Control
T2 - Composted coirpith (12.5t ha -1)
T3 - Composted pressmud (12.5t ha-1)
T4 - Farmyard manure (12.5t ha-1)
T5 - NPK (100%)
T6 - Composted coirpith (12.5t ha-1) + 50% NPK
T7 - Composted pressmud (12.5t ha-1) + 50% NPK
T8 - Farmyard manure (12.5t ha-1) + 50% NPK
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T12 - Composted coirpith (6.5t ha-1) + Composted pressmud (6.5t ha-1) + Farmyard manure (6.5t ha-1).

in soil organic carbon under farmyard manure (0.52%) than organic carbon under cowpea green manure (0.46%) at a depth of 7.5-15cm.

Available NPK

The maximum available NPK was found in T_{12} (95, 13.09 and 445 kg/ha) followed by T_9 (90, 13.00 and 431 Kg ha^{-1}) when compared to control T_1 (60, 5.54 and 307 Kg ha^{-1}). According to Zamanov *et al*. (2002) only the organic fertilizers could raise the humus maintenance in soil. They were a source of carbon for replenishing humus loses, improving the physical properties of soil and enhancing the mineralization of organic matter.

Available sulphur

The maximum available sulphur was estimated in T_{12} (68.12 ppm) followed by T_9 (64.10 ppm) when compared to control T_1 (18.09 ppm). Sushma *et al*. (2007) obtained a highest available sulphur content of 67.0mg ha^{-1} in coirpith based compost (CPBC) + pressmud (45t ha^{-1}) and 100% recommended dose of fertilizer in the soil after harvest of ragi crop.

Available copper, zinc, iron and manganese

The maximum copper, zinc, iron and manganese was found in T_{12} (2.05, 2.93, 7.80 and 8.39 ppm) followed by T_9 (2.02, 2.90, 7.60 and 8.01ppm) as compared to control T_1 (2.00, 0.91, 4.38 and 4.22 ppm). According to Rangaraj *et al*. (2007), Zn (2.84, 2.95ppm), Fe (13.2, 13.5 ppm), Cu (0.75, 0.75ppm) and Mn (3.57, 3.59ppm) were found to be higher in the soil supplemented with pressmud (12.5t ha^{-1}) during the post monsoon in 2003 and 2004.

Conclusion

The present work is to highlight the possibilities of using the agroindustrial wastes like coirpith, pressmud and farmyard manure in promoting the crop productivity. Composted coirpith and pressmud produced by the degradation of ligno-cellulolytic fungi (*Pleurotus sajor-caju*) and farmyard manure was found to be an efficient organic manure as it enhanced enzymatic activity of the soil and cycling of nutrients in the environment and reduce the quantity of the waste accumulation in the disposal site. This technology provides an alternate solution for the disposal of coirpith and pressmud. A fairly good concentration of nitrogen, phosphorus, potassium and micronutrients makes coirpith and pressmud, a potential role player in enhancing the soil fertility and crop productivity.

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