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QUALITY OF COIRDUST COMPOSTS AND THEIR EFFECT ON THE DRYMATTER YIELD OF MAIZE

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Abstract: Composting of coirdust was done with various organic and inorganic additives in various combinations. Coirdust, which had high C:N ratio (93.77) and L:N ratio (106.0) could be convened to good quality composts with 21.91 to 34.07 C:N ratio and 18.78 to 25.49 L:N ratio. The organic carbon, lignin, cellulose and total phenol content decreased while contents of major, minor and micronutrients increased upon composting of coirdust in all the compost treatments. Coirdust compost charged with garden weeds, glyricidia, rock phosphate and micronutrients along with 50% recommended fertilizer dosage recorded significantly higher drymatter yield over recommended practice. Hence, this super quality compost could be used as an effective component in integrated nutrient management.

Key words : coirdust, compost, C:N ratio and L:N ratio

INTRODUCTION

Successful management of resources along with maintaining the quality of environment and conserving the resources is a must for sustainable land management. This includes the efficient utilization of agro-industrial organic wastes like coirdust, which pose the problems of disposal and environmental hazards in coconut growing states. Coirdust is a light, fluffy refuse with higher lignin content produced from coir industry. In India, about 60 Mt of coirdust is produced annually (Aravindakshan, 1994). Direct application of large doses of non-degradable ligno-cellulosic wastes to soil often leads to unfavourable effects on crop production. A proper piling and composting of these wastes before incorporation to the field is considered to overcome the problems associated with the disposal of biodegradable wastes in soil. One of the main obstacles to successful utilization of coirdust in agriculture is the lack of reliable protocol for composting to get high quality composts. Though, there are reports on coirdust composting with inorganic N sources and lignin degrading fungi like *Pleurotus sajorcaju*, the preliminary studies by Anand *et al.* (1998) revealed that mere addition of these does not encourage faster decomposition and optimum humification. Hence, better protocols are to be evolved. Therefore, four sets of composting were tried after preliminary trials (Anand *et al.*, 1998) based on quality parameters and efficiency in field performance.

MATERIALS AND METHODS

Composting of coirdust was carried out with different organic and inorganic additives viz., *Pleurotus sajorcaju*, cow dung, garden weeds, glyricidia, rock phosphate, micronutrients and urea in different combinations based on protocols developed by Anand *et al.* (1998) and Kadalli and Devi (1999). The compost treatments are given in Table 1. *Pleurotus sajorcaju* was the microbial inoculum used to enhance the lignin degradation @ 1 kg per tonne of coirdust. Cow dung, garden weeds and glyricidia were used @ 5, 10 and 15% on fresh weight basis respectively. Rock phosphate (RP) was used for P fortification @ 5% (1.25% P_2O_5) on dry weight basis. Urea was used as N source in C_4 compost @ 2% N on dry weight basis. Micronutrients Zn, Fe and Mn were added @ 200 ppm and Cu @ 20 ppm. The C2 compost was prepared by pretreating the coirdust with lime (calcium hy-

Table 1. Different organic and inorganic additives used for the compost preparation

C_1	Coirdust + *Pleurotus* + cow dung + garden weeds + glyricidia + rock phosphate + micronutrients
C_2	Coirdust (L)* + *Pleurotus* + cow dung + garden weeds + glyricidia + rock phosphate + micronutrients
C,	Coirdust + *Pleurotus* + cow dung + garden weeds + glyricidia + rock phosphate
C_4	Coirdust + *Pleurotus* + cow dung + urea + rock phosphate + micronutrients

*Lime pretreated coirdust

hydroxide) @ 5% WAV. Required quantity of lime was dissolved in water and sprinkled to maintain around 60% of the maximum moisture holding capacity of the material. The composts were mechanically turned at monthly intervals and again packed after thorough mixing. Composting was terminated after 120 days. Compost samples were analyzed for nutrient parameters using standard procedures after digesting them in the diacid mixture (Piper, 1966). The biochemical properties like lignin, cellulose and total phenols were determined following procedures outlined by Sadasivam and Manickam (1996) with a slight modification by carrying out hydrolysis with 72% H_2SO_4 for complete digestion of cellulose.

Table 2. Experimental details for the field experiment

T,	$N_0P_0K_0$ (absolute control)
T_2	100% RDF
T_3	100% RDF + FYM @ 10 t ha^{-1} (control)
T_4	50% RDF + C_1 compost @ 10 t ha^{-1}
T_5	50% RDF + C_2 compost @ 10 t ha ^{1}
T_6	50% RDF + C_3 compost @ 10 t ha^{-1}
T_7	50% RDF + C_4 compost @ 10 t ha^{-1}
T_8	50% RDF + raw coirdust @ 10 t ha^{-1}

The composts were tested for efficiency in the field in terms of drymatter production of maize (variety Deccan Hybrid) in GKVK Farm, UAS, Bangalore. The design used was RCBD with eight treatments and three replications. The recommended dosage of fertilizers (RDF) was 150 kg N, 75 kg P_2O_5 and 40 kg K_2O per hectare. The treatments used for the experiment are given in Table 2. The site was thoroughly leveled and plots of size 1 x 1.5 m^2 were prepared and the composts or FYM were applied and mixed thoroughly. The crop was raised and maintained by following the recommended package of practices. The crop was harvested after 60 days of sowing and the drymatter yield was determined.

RESULTS AND DISCUSSION

Coirdust had pH 6.25, EC 0.42 dS m^{-1} and 47.64% OC. It contained 0.47% N, 0.02% P, 0.62% K and was rich in micronutrients with 47.66 ppm Zn, 14.93 ppm Cu, 1244.33 ppm Fe and 61.33 ppm Mn. It also contained 49.84% lignin, 35.05% cellulose and 108.42 mg kg^{-1} total phenols. The C:N ratio was 93.77 with L:N ratio of 106.0. Cow dung had

Table 3: Chemical and biochemical properties of coirdust composts

Parameters	C_1	C_2	C_3	C_4
PH	6.80	7.20	6.83	6.81
EC (dS m^{-1})	0.42	0.44	0.42	0.50
OC(%)	32.30	34.76	33.85	30,24
N (%)	1.18	1.02	1.06	1.38
P(%)	1.14	1.08	1.06	1.28
K (%)	0.98	0.96	0.94	1.00
Ca (%)	1.94	2.75	1.84	1.67
Mg (%)	0.26	0.28	0.30	0.36
S (%)	0.32	0.34	0.32	0.40
Zn (ppm)	1260	1030	875	1120
Cu (ppm)	71	54	40	56
Fe (ppm)	5060	4820	3680	4870
Mn (ppm)	560	460	310	520
CEC (cmol kg^{-1})	76.81	86.90	75.94	73.99
C:N ratio	27.37	34.70	31.93	21.91
Liginin (%)	26.42	22.68	27.02	25.92
Cellulose (%)	19.04	25.12	19.15	18.12
Total phenols (mg 100 g^{-1})	58.10	69.20	57.40	49.70
L:N ratio	22.38	22.23	25.49	18.78

Table 4. Dry matter yield of maize 60 days after sowing as influenced by coirdust composts

Treatment	Yield (g m^{-2})
T_1	60.06
T_2	171.42
T,	211.72
T_4	242.42
T_5	229.00
T_6	215.24
T_7......	235.20
T_8	90.48
SEm $\pm$	3.97
CD (0.05)	11.90

48.82% OC and 1.28% N with C:N ratio of 38.14. It also contained 19.84% lignin, 12.84% cellulose and 61.42 mg $100g^{-1}$ total phenols. It was used as a starter for composting and to enhance the decomposition of cellulosic plant materials. Garden weeds had 31.80% OC, 3.88% N, 1.85% K with 13.35 C:N ratio and it also contained 17.85% lignin, 19.64% cellulose and 172.50 mg $100g^{-1}$ total phenols. Glyricidia had 33.92% OC, 3.28% N, 1.71% K with C:N ratio of 10.35 and it registered 10.80% lignin, 20.42% cellulose and 85.54 mg $100g^{-1}$ total phenols. As garden weeds and glyricidia were having high N and are easily degradable, they were used as organic N sources in composts to enhance decomposition of coirdust

The chemical and biochemical properties of the matured coirdust composts are given in Table 3. The pH of the lime-pretreated compost was high due to alkali treatment. The pH and EC of all the composts were in the acceptable limits and hence ideal for application to all types of soils. The N content of the composts ranged from 1.02% (C_2) to 1.38% (C_4) and the OC content ranged from 30.24% (C_4) to 34.76% (C_2). The C:N ratio has been drastically reduced to 21.91 (C_4), which was possible due to increase in N content and loss of carbon as CO2. C:N ratio was least in inorganic N treated compost which was not only due to incorporation of N as urea but also due to omission of carbon rich garden weeds (31.80%) and glyricidia (33.92%). The enrichment of composts with RP has increased the P content of the composts to 1.06% (C_3) & 1.28% (C_4). The K, Ca, Mg and S contents of the composts were also high compared to original coirdust due to enrichment with additives and due to mass loss. The composts enriched with micronutrients resulted in higher micronutrient content over non-enriched compost (C_3). Lime pre-treated coirdust compost recorded maximum CEC among all the composts. Cation exchange capacity of coirdust composts is high when compared to composts of other wastes reported elsewhere (Garcia *et al.* 1992), which was due to high lignin content in coirdust which is rich in functional groups.

Lignin, cellulose and total phenol content had decreased on composting of coirdust. Lime pretreatment had resulted in higher lignin degradation due to weakening of lignin structure, which resulted in increased polyphenol production. So, this compost (C_2) has low lignin and high phenol content compared to other composts. Cellulose content was high in lime-pretreated compost, which may be due low cellulase activity, which was due to high pH (Stutzenberger *et al.* (1970). Chemical N treated compost (C_4) recorded lower lignin, cellulose and total phenols due to non-inclusion of glyricidia and garden weeds as additives. The L:N ratio, which is a good index of substrate quality for litters of high to medium lignin content (Taylor *et al.*, 1989) had decreased upon composting. Decreased L:N ratio indicates higher substrate quality and hence found suitable for field application.

The soil at the experimental site was Typic Kandiustalfs and texture was sandy loam. Soil was slightly acidic to neutral (pH 6.73) with EC 0.16 dS m^{-1}. It was low in organic carbon (4.30 g kg^{-1}), low in available nitrogen (166.16 kg ha^{-1}), medium in available P_2O_5 (26.06 kg ha^{-1}), and low in available K_2O (140.00 kg ha^{-1}), and with CEC 12.94 cmol (p^+) kg^{-1}.

The data on drymatter yield of maize after 60 days of sowing are given in Table 4. Highest dry matter yield was recorded in treatment T_4, which received 50% RDF along with organic N, RP and micronutrient enriched coirdust compost while least yield was recorded in absolute control. C_3 compost treatment (T_6) recorded significantly lower drymatter yield over all compost treatments (T_4, T_5 and T_7) and was significantly on par with control (T_3). Treatment T_4 recorded significantly higher dry matter yield compared to T_5 and T_6 and was significantly on par with T_7. Lime pretreated coirdust compost treatment (T_5) recorded significantly lower drymatter yield over T_4 but was significantly on par with T_7. All coirdust compost treatments except T_6 recorded significantly higher dry matter yield over control. Raw coirdust treatment (T_8) recorded significantly lower dry matter yield over control and compost treatments. The increased drymatter yield with coirdust composts may be attributed to the positive effect of these composts on the physical, chemical and biological properties of soil and consequent effect on the plant growth. Based on the dry matter yield of maize, the quality of composts can be arranged in decreasing order of $C_1>C_4>C_2>C_3$. Application of compost resulted in significantly higher N, P_2O_5 and K_2O contents of post-harvest soils compared to control. From these results, it can be inferred that it is possible to save 50% of inorganic fertilizer without sacrificing the yield with the addition of coirdust enriched composts and SO can be successfully introduced into integrated nutrient management Systems to sustain productivity.

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