Microbial Technology for the Management and Effective Utilization of Coir Pith Wastes

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***Abstract*—**Coir pith is a biomass residue generating during the coir extraction of coir fiber from coconut husk. These coir pith waste have been disposed by burning. During this burning has resulted in various environmental problems. Leaching of coir pith is harmful to aquatic and soil microflora. Microbial degradation of coir pith waste is generally considered to safe, effective and eco-friendly. Effective utilization of coir pith waste is done by composting. Composting has become an increasingly important strategy for the treatment of organic wastes. In order to evaluate the process and the quality compost two fungal species and a bacterial species such as Pleurotus sajor caju, Phanerochaete chrysosporium, Cellulomonus fimi were selected to degrade coir pith. All the selected species were degrading coir pith and showing 89.5% degradation of lignin and 92% of cellulose. The coir pith compost shows excellent medium for soil and it contains high water holding capacity.

***Keywords*—** Pleurotus sajor caju, Phanerochaete chrysosporium, Cellulomonus fimi Coir pith and compost.Coir pith and compost.

I. Introduction

WELCOME to Coir industry is one of the important cottage industries in India contributing significantly for creation of livelihood in major coconut growing states and union territories. Coir fiber is the raw material of the industry and during the extraction process coir pith is generated in large quantities as waste. About 10.5 million tons of coir pith is produced annually in India. Since the coir board contributes to the sustainable development and also creation of environment friendly products *viz.*, application for domestic use and also in housing, building and agriculture and infrastructure development significantly. In raining seasons the tannins and phenol leached out from coir pith loads into soil this is serious problem and make agricultural and unproductive. Such leaching is harmful to the aquatic and soil micro flora. Therefore alternative ways to dispose of coir pith, such as composting is of suitable importance of these areas. Coir pith thus produced decomposes very slowly in the soil as its pentosan : lignin ratio below 0.5 and because of the chemical and structural complicity of its lignin cellulose complex .This ligno-cellulosic waste material consist of lignin 30-40%, cellulose 40-50%, hemicelluloses 15-35%, protein 2.04%, organic matter 87%, organic carbon 6.28%, nitrogen 0.73% and ash 13%. In this fluffy, light, spongy material with increases water holding capacity .Microbial biodegradation of this coir pith have been found effective using *Cellulomonas fimi*, *Phanerochaete chyrosporium* and *Pleurotus sajar caju* as cellulose and lignin degradation. Bio compost is the viable process that means converting this organic substance to beneficial product such as compost and other soil conditioner. Composting has become an increasingly important strategy for the treatment of organic wastes

In order to evaluate the process and quality of the end product, better knowledge of the microbial community and population dynamics is needed. It has been demonstrated that compost is applied to agricultural fields as long-term fertilizer, to improve soil structure as a substitute for peat in horticulture, as a suppressive agent against plant pathogens and as a microbial additive to increase enzyme activity.

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II. Material and Methods

Coir pith was collected from M/S Vinoth coir industries, Puthupalayam, Cuddalore dist, Tamil Nadu state,India. The microbial cultures obtained from MTCC, Chandigarh *Pleurotus sajor-caju* (1806), *Phanerochaete chrysosporium*(787), *Cellulomonas fimi*(24), for coir pith composting 8 treatments were laid and each treatment carry three replications. The treatment details are as follows:

T1 - *Cellulomonas fimi* (CPB3)
T2 - Phanerochaete chrysosporium (CPF7)
T3 - Pleurotus sajor caju (CPF13)
T4 - Cellulomonas fimi (CPB3) + Phanerochaete chrysosporium (CPF7)
T5 - Cellulomonas fimi (CPB3) + Pleurotus sajor caju (CPF13)
T6 - Phanerochaete chrysosporium (CPF7) + Pleurotus sajor caju (CPF13)
T7 - *Cellulomonas fimi* (CPB3) + *P. chrysosporium* (CPF7) +Pleurotus sajor caju (CPF13)
T8 - Control (Un-inoculate)

Randomized block design (RBD) was followed with three Replications.

III. Results and Discussion

During composting process, the organic carbon showed a decreased trend. On the 90th day of composting T_8 showed the maximum of 30.00% organic carbon whereas rest of the treatments showed reduction in organic carbon lies between29.00 per cent to 22.0 percent. Changes in temperature

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during composting of coir pith showed the maximum temperature of 69°C was recorded on 2nd week of composting (T_7). The C: N ratio of the substrate narrowed down during composting (Table-1).

TABLE I:
EFFECT OF INDIVIDUAL, DUAL AND CONSORTIUM OF INOCULANTS ON THE COMPOSTING OF COIR PITH WASTES.

S.No	Treatments	Parameters					
		75 Days after Composting					
		Temperature (°C)	Organic carbon (%)	C:N ratio	Cellulose content (%)	Hemicellulose content (%)	Lignin content (%)
1.	T_1-*Cellulomonas fimi*(CPB3)	35	27.56	39.37	11.00	5.25	6.20
2.	T_2-*Phanerocheate chrysosporium*(CPF7)	35	28.18	38.08	11.00	6.40	6.20
3.	T_3-*Pleurotus sajorcaju*(CPF13)	35	24.88	34.08	11.00	5.20	6.0
4.	T_4-*Cellulomonas fimi*(CPB3) +*P.chrysosporium*(CPF7)	32	23.96	22.18	10.50	3.20	5.50
5.	T_5-*Cellulomonas fimi*(CPB3) +*Pleurotussajorcaju* (CPF13)	32	22.99	20.90	9.60	2.83	4.90
6.	T_6-*Pleurotus sajorcaju*(CPF13) + *P.chrysosporium*(CPF7)	32	23.21	21.29	10.50	2.90	5.40
7.	T_7-*Cellulomonas fimi*(CPB3) + *P.chrysosporium* (CPF13) +*Pleurotussajarcaju* (CPF13)	32	22.88	19.89	9.00	2.75	4.60
8.	T_8-Control	42	30.00	48.38	22.00	11.35	9.60
	SE	1.02	1.09	0.52	1.02	0.01	0.38
	CD(P=0.05)	2.03	2.05	1.08	2.07	0.02	0.76

The dual inoculants of compost required 75 days of composting to attain a C: N ratio of 22.35. On the other hand, single inoculants treatments T_1, T_2, T3 revolved coir pith required 90 days to attain the C: N ratio of 34.08. The data on cellulose, hemicellulose, and lignin content during composting is presented in Table -I.

The cellulose content of coir pith was initially 27.00 per cent but decreased to 75th day of composting in the treatment T_7. However, dual inoculants treatment (T_4,T_5,&T_6) achieved this level of 9.60 percent only on the 90th day. The same trend was noticed for hemicelluloses and lignin degradation of the coir pith compost during composting period (Table.II). The coir pith treated with triple inoculants showed nitrogen 1.15 percent, Phosphorous 0.26 percent, Potassium 1.39 percent, Calcium 1.09 percent, Magnesium 0.62 percent, Sulphur 0.44 percent ,Zinc 34 $mgKg^{-1}$ and Iron 20 $mgkg^{-1}$ on the 90th day. While the coir pith compost produced without microbial inoculants contained 0.26 percent N,0.01 percentP,0.55 percent K,0.46 percent Ca,0.36 percent Mg,0.10 percentS,7.5 mg Zn and 2.00 mg Fe. However, no other treatment of this study showed such higher nutrient values after composting.

TABLE II:
COMPARATIVE NUTRIENT STATUS OF COIR PITH, COIR PITH COMPOST AND IMPROVED COIR PITH COMPOST

S. No	Parameters	Coir pith	Coir pith compost	Improved coir pith compost
1.	pH	6.1	6.2	6.5
2.	EC	0.40	0.25	0.33
3.	Organic carbon (%)	36.70	24.88	22.88
4.	Total nitrogen	0.48	0.73	1.15
5.	C:N ratio	76.45	34.08	19.89
6.	Total phosphorous (%)	0.11	0.10	0.26
7.	Total potassium (%)	0.51	0.99	1.30
8.	Total calcium (%)	0.46	0.92	1.09
9.	Total magnesium (%)	0.33	0.53	0.62
10.	Total sulphur (%)	0.10	0.22	0.44
11.	Total zinc (%)	7.50	16.00	34
12.	Total iron (mg)	2.00	8.00	20
13.	Cellulose (%)	27	11.10	9.00
14.	Hemicellulose (%)	28.25	5.20	2.75
15.	Lignin (%)	30	6.00	4.60
16.	Bacteria ($x10^5$ cfu g^{-1})	6.00	47.00	71.00
17.	Fungi ($x10^3$cfu g^{-1})	4.00	23.00	34.00

18.	Actinomycetes ($x10^3$ cfu g^{-1})	5.00	22.95	27.00

IV. Conclusion

In conclusion, Triple inoculants (consortium) consist of *Cellulomonas fimi* + *Phanerochaete chrysosporium* + *Pleurotus sajor caju* (treatment 7) found to be highly suitable for the development of coir pith compost. The composting process showed higher levels of available N, P, and K, Ca, Mg, and S during the period of compost

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