Indian J.L.Sci. 6 (1) : 55-59, 2017

ISSN : 2277-1743 (Print)
ISSN : 2278-7879 (Online)

COMPARITIVE STUDIES OF THE EFFECT OF DIFFERENT MICROORGANISMS ON COIR PITH COMPOSTING

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ABSTRACT

Coir pith is a highly lingo cellulosic material is available in large quantities as a byproduct of coconut coir industry. Technology for degrading coir pith with different lignocellulolytic organisms help to convert it as nutrient rich organic manure. The work aimed to compare the degrading capability of five fungi *Trichoderma harzianum*, *Penicillium* sp, Pleurotus florida, *Calocybe indica* and *Aspergillus flavus* and two bacteria viz. *Bacillus* sp and *Pseudomonas fluorescence* on coir pith and to find out the efficient degrader. Among the micro organisms tested, *T. harzianum* showed significant increase in growth, reduction in organic carbon, increased nitrogen content, reduction in C:N ratio and reduction in weight of coir pith followed by *P. florida* and *Penicillium* sp. *Trichoderma* caused 45.35% reduction in organic C content followed by *Penicillium* sp, *A. flavus* and *P. florida* causing 31.47, 25.13 and 21.92% reduction respectively.. Apart from reducing carbon increase in nitrogen content was caused by *P. florida* followed by *C. indica*. Bacteria are found to be inefficient degraders. Mass production studies indicate that coir pith can be converted into nutrient rich bio manure using *T. harzianum* or *P. florida* and urea following the standard technology.

KEYWORDS : Coir, *Calocybe indica, Aspergillus flavus*

About357 million tones of biodegradable agro wastes such as cotton waste, different straws and other market waste are being generated in India. In India about 7.5 million tones of coir pith, a byproduct of coir industry is being produced annually (Kamaraj) of which major contribution is from Kerala. Nutrient value of coir pith is very low and hence it cannot be used as manure. Coir pith is a lignin rich recalcitrant agriculture waste with wide C: N ratio and high tannin and phenolic compounds. Therefore it is difficult to degrade and cause disposal problems. At the same time, it has excellent water holding capacity and contains both macro and micro nutrients (Ulmer et al., 1984; Poincelot , 1974; Krik, 1987).

Retted and non retted coir pith are available. Retted coir pith is obtained after subjecting coconut husk for retting in back waters for 4-12 months and beating them by wooden logs or mallets. The fiber obtained by retting process is of superior quality but there is heavy nutrient loss. Non retted coir pith is obtained by subjecting coconut husk in fiber extracting machines. Hence they are rich in nutrients (Kadali 2000; Hong et al., 1985; Natarajan et al, 1990).

Studies (Owseph, 1999 and Reeja, 2002) have indicated that the possibility of converting coir pith into useful biomass through bioremediation. Bioremediation is a biological process of degradation of contaminated substrate using specific microbes. Composting of coir pith helps in denitrifying phenolic compounds, reducing bulkiness of material and converting nutrient into more readily available form to plants. In order to convert the macro and micro nutrients in coir pith into organic manure, it has to be degraded for which microorganisms play an important role. Many basediomycetes flora are found to efficient degrader of coir pith (Chang and Miles, 1989; Bidappa et al., 1985).

Any organic manure having wider C: N ratio offer stiff resistance to microbial degradation which results in setback in the growth of crops temporarily. Reduction of Carbon and increase of nitrogen content resulting in narrowing down the C: N ratio is necessary before the organic material is applied to soil. Among the several methods suggested for narrowing down the C: N ratio, composting has been found to be the most useful method with certain advantages (Bhowmie and Debanth 1985; Azizi et al., 1990).

Aim of the study is to compare the extent of degradability of coir pith using different native micro organisms present in coir pith and to assess the manurial value of degraded coir pith (Rama et al., 2000, Arora and Sandhu, 1985).

MATERIALS AND METHODS

The materials left after extraction of coir fiber from coconut husk which composed of coconut coir pith along with small bits of coir fiber and retted husks, were collected from Vazhamuttom area of Trivandrum district,

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Kerala. These materials are used for the isolation of Fungi and Bacteria.

Isolation

Lignolytic microbes from the above mentioned materials were isolated by adopting serial dilution technique (Johnson and Curl., 1972). Isolation of mushroom flora (*Pleurotus florida* and *Calocybe indica*) were done by tissue culture method.

Spawn Preparation

Paddy grain spawn of *Pleurotus florida* and *Calocybe indica* were prepared by adopting the method. Paddy grains boiled in water till the husk splits. After draining excess water, it is mixed with Calcium carbonate, at the rate of 50kg per paddy grain to prevent adhesion of grains for optimizing PH of the spawn run. Glucose drip bottles of 750 ml capacity or polypropylene cover were filled with the grains to two third of its capacity, plugged with cotton and autoclaved at 1.05kg/cm^3 for two hours. Inoculation of the grains with pure culture of *P. florida* and *C. indica* were carried out and incubated at room temperature 28±4^{0}C. The nature of growth and time taken for the complete mycelia colonization of the grains were recorded. The spawn thus prepared was used for the degradation trials.

Screening of Cultures for Selecting the Most Efficient Fungi for Degradation

Retted coir pith (150g) was taken in polypropylene bag (figure 1) is sterilized and inoculated by transferring mycelia bits under asceptic conditions. Incubated at room temperature. Observations were recorded regarding Nature of mycelia growth, Time taken for the complete colonization of coir pith, Carbon content of coir pith, Nitrogen content of coir pith, Reduction in weight of coir pith, Assay of Organic carbon and Total nitrogen of composted coirpith.

Assay of Total Organic Carbon and Total Nitrogen of Composted Coir Pith

The organic carbon content of the coir pith samples composted with various test organisms were estimated following Walkey and Black's rapid titration method. In this method coir pith sample was allowed to react with potassium dichromate and concentrated sulphuric acid. Contents of the flaks were titrated against

Table 1 : Percentage of Reduction of Organic Carbon, Increase of Nitrogen Content and the Nature of Mycelial Growth on Composted Coir Pith

Sl No	Micro organism	Nature of growth of mycelium	Carbon content After 30 days of incubation	% of reduction of Carbon over control	Nitrogen content After 30 days of incubation	% of increase of Nitrogen over control
1	*T. harzianum*	++++	17.05	43.35	0.88	252.00
2	*Penicillium sp.*	+++	21.38	31.47	0.79	216.00
3	*P.florida*	++	24.36	21.92	1.10	340.00
4	*C.indica*	+++	28.08	10.00	0.92	268.00
5	*A.flavus*	++	23.36	25.13	0.86	244.00
6	*Bacillus sp.*	-	30.81	1.25	0.41	64.00
7	*P.fluorecens*	-	30.17	3.30	0.39	56
8	Control		31.20		0.25	

ferrous sulphate solution using ferroin as indicator.

Total nitrogen content of the sample was estimated by using m modified micro Kjeldal method. The method involves two steps. First step is the digestion of sample to convert organic form of nitrogen to ammonia by the reaction of sample with sulphuric acid and catalyst Kjeltabs (potassium sulphate +copper sulphate) in kjeldal system. The liberated ammonia was collected in 20ml 4% boric acid which was titrated against 0.01N hydrochloric acid.

RESULTS

Following Lignolytic micro organisms were obtained from native microbial flora of coir pith by serial dilution plate technique.

1. *Trichoderma harzianum* 2. *Penicillium* sp 3. *P. florida* 4 .*Calocybe indica* 5. *Aspergilluus flavus* 6. *Bacillus* sp 7. *Pseudomonad fluorescence*

The result presented in table 1 shows that thick and fluffy mycelia growth was observes in case of *Trichoderma harzianum* followed by *Penicillium* sp and *Calocybe indica*. The growth was moderately thick in case of *A.flavus* and *P. florida*. Very poor growth was observed in the case of *Bacillus* and *Pseudomonas*.

Table 2 : Effect of Microorganisms in C:N Ratio After 30 Days of Incubation

Sl No	Micro Organism	C:N Ratio After 30 Days of Incubation
1	*Trichoderma harzianum*	19.38
2	*Penicillium sp.*	27.06
3	*P.florida*	22.15
4	*C.indica*	30.52
5	*A.flavus*	27.16
6	*Bacillus sp.*	75.15
7	*P.fluorecens*	77.36
8	Normal	124.80

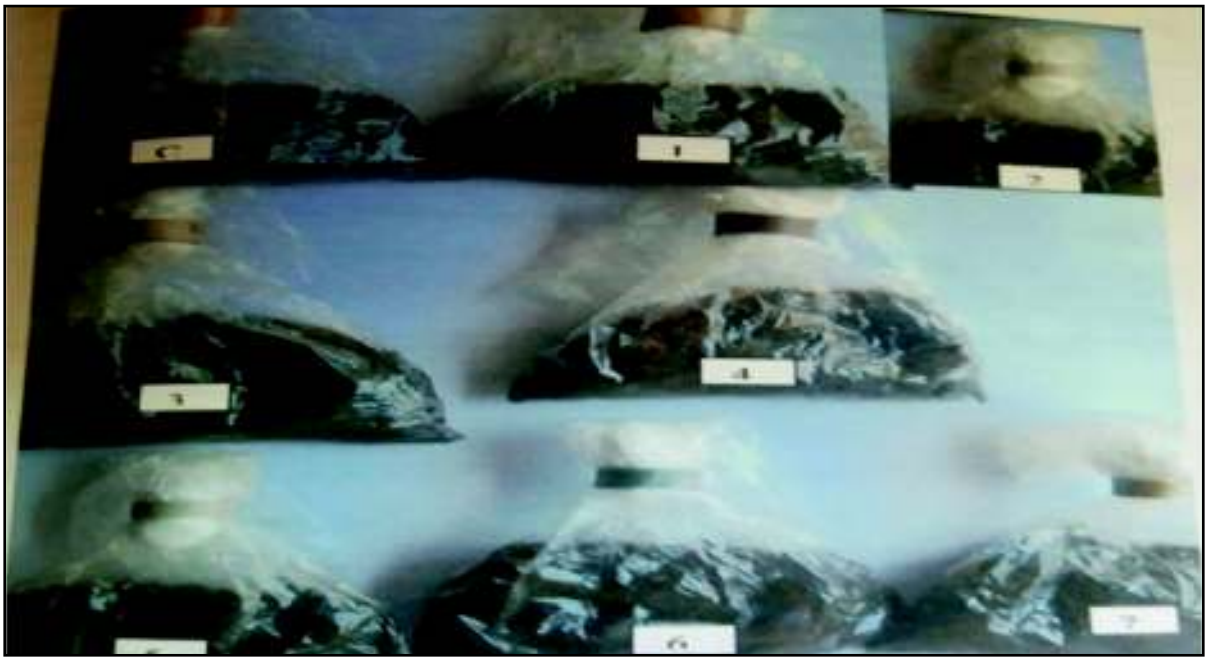

Figure 1 : Coir Pith Inoculated with Specific Microorganisms in Polypropylene Bag

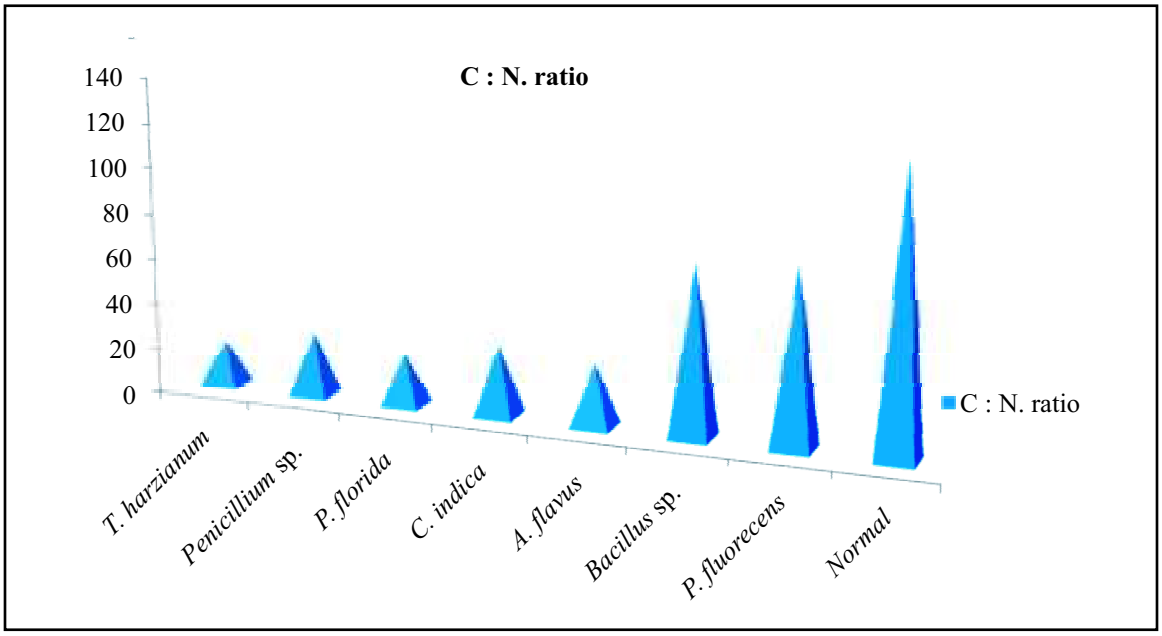

Figure 2 : C :N Ratio of Composted Coir Pith After 30 Days of Incubation

The result of the effect of Micro organisms on the carbon content of the coir pith are presented in table 1.The maximum reduction in organic carbon content (45.35%) was recorded by *T. harzianum*, reducing carbon content from 31.20% to 17.05% followed by *Penicillium* sp, *Aspergillus flavus* and *P. florida*. *bacillus* sp and *P. fluoresens* are found to be the least efficient degraders which produced 1.25 and 3.30% reduction of Organic carbon.

All the micro organisms tested caused increase in Nitrogen content as the result of degradation. *P. florida* produced the maximum increase in nitrogen content followed by *C. indica* which caused 0.92% nitrogen content compared to 25% in control.

C:N ratio of retted coir pith was found to be 124.8:1.0 and after degradation C:N ratio was diminished. *Trichoderma harzianum* produced the maximum reduction of C:N ratio to 19.38:1 followed by *P. florida* (22.15:1) and *Penicillium* sp (27.06:1). Both the bacteria caused lower reduction in C: N ratio (Table 2 and Figure 2).

DISCUSSION

Nowadays organic manures are important in Agriculture since they play an important role in sustaining soil productivity and increase in crop production. Hence coir pith compost is boon to farmers. By composting plant nutrients present in raw coir pith is converted to a form more readily available to plants. Besides it has high potential to improve the water holding capacity of soil and modify the physical and chemical properties of the soil.

The decomposition of coir pith is caused by the means of enzyme liberated by organisms growing on it. The reduction in C: N ratio is due to the microbial utilization of coir pith and by immobilization of nitrogen into cells of colonizers. Most of carbon is released as carbon di oxide and nitrogen remained entrapped in fungal cell and remained in decomposed crops which account for the increased nitrogen and decreased carbon content. Nitrogen fixing ability of higher fungi also contributes the increased nitrogen content of coir pith compost.

The decomposition reduces the volume of coir pith in the present study. All the micro organisms caused reduction in weight from 11.78-60.475 weight reduction due to the formation of Carbon dioxide and other

degradation products and many water soluble intermediaries (Abraham and Chakrabarthy 1992, Thayamanavan, 1980).

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