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Effect Of Microbial Consortium On The Composting Of Coir Pith Waste

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ABSTRACT

Cellulolytic microorganisms isolated form Coir pith waste has been utilized for the production of compost. For the fastening of the period of composting, single, dual and triple inoculants of microorganisms was used. The periodical changes in dehydrogenase activity. C:N ratio and germination test were measured. The Dehydrogenase activity and C:N ratio was satisfactory in all the compost and they were well within the limit. The compost germination percentage was more than 90 which confirmed the non-existence of phototoxic compounds. The triple inoculants (consortium) were significant on the period of composting when compared to single or dual inoculants.

Keywords: Coir pith waste, Dehydrogenase, C:N ratio, Germination.

INTRODUCTION

Coconut forms a significant fraction of the economy of many countries. India produces 22 percent of the word total Coconut production and is being considered as a premier coconut producer in the world [1]. Total generation of coir pith in India is estimated to be around 5.0 million tones per year while the world production is around 3.6 million tones [2]. The coconuts are processed in industries to yield oil. The above process generates huge quantities of husk, which was considered to be a waste [3]. These husks are now being utilized as a raw material for the production of coir fiber. During the extraction of coir fiber from the husk, a light weight spongy material is released. This spongy material is referred to as coir pith which accounts for 50-60 percent of the total weight of the husk.

In order to restrain from the possibility of adverse effects due to improper disposal of coir wastes, there needs a healthier and productive way of utilizing these wastes. Scientific method of preparing enriched compost using decomposition technique involving microbes can render this waste fit for agricultural use. Though there has been technologies for conversion of coir waste into usable products, exploitation of these technologies are very much limited. Among these technologies, composting is the best option to overcome or minimize pollution and convert these coir pith wastes into enriched organic manures. Composting is a method of solid waste management whereby the organic compound of solid waste is biologically stabilized by the action of some microorganisms under controlled conditions [4]. Thus careful and systematic

management of coir pith should be aimed at achieving maximum recycling of nutrients with minimum losses.

Coir pith can be very well recycled using effective microorganisms without causing environmental hazards. Coir pith which is generally rich in nutrients favours the rapid growth of microorganisms. Even though the composting technology is efficient there are still many parameters to be improved. Some of them include reduction in overall time taken for composting and developing efficient decomposing microorganisms. Investigations were therefore undertaken to study the effect of microorganism on the periodical changes in dehydrogenase activity, C:N ratio and germination percentage of compost.

MATERIALS AND METHODS

Coir pith waste was composted by employing pectinolytic cultures viz., Bacillus sp, Pseudomonas fluorescens and Trichoderma reesei isolated from coir pith waste. The organism were selected based on its enzyme production. The treatment details are as follows:

T1 - *Bacillus sp*
T2 -*Pseudomonas fluorescens*
T3 -*Trichoderma reesei*
T4 -*Bacillus sp + P.fluoresecens*
T5 -*Bacillus sp + T. reesei*
T6 -*P.fluorescens + T. reesei*
T7 - *Bacillus sp + P.fluorescens + T.reesei*
T8 - Control

Design: Randomized block design with three replications

Microbial inoculants were added at the rate of 5L of broth culture ton^{-1} of waste. Urea was added at 0.5 percent .Moisture level of 55-60 percent was maintained by uniformly sprinkling the water at regular intervals. Turnings were given at fortnightly intervals. Samples were withdrawn at periodical intervals for analyzing the dehydrogenase activity and C:N ratio by standard methods. The germination test was assessed by following the method described by Sequi et al., [5]

RESULTS AND DISCUSSION

The survival and microbial activity of the entire composting process was studied by estimating dehydrogenase activity at 0, 30, 60 and 90 days of composting and the results are presented in table 1. The dehydrogenase activity relates to the microbial activity in a substrate. All the treatments showed dehydrogenase activity throughout the composting periods but the degree of activity varied during the composting periods. Individual inoculant treatments T1, T2 and T3 were more or less on par. The dual inoculants T4 performed better than T5 and T6. The triple inoculants treatment T7 recorded maximum dehydrogenase activity on the 60th day (4.10 mg of formazon formed h^{-1} g^{-1}). All the treatments showed increased enzyme activity from 30th day onwards up to 60th days and thereafter decreased. There was least dehydrogenase activity in the uninoculated control T8. The presence of activity throughout the composting period showed better survival and activity of the microbial population. The individual and dual inoculants treatment showed reduced dehydrogenase activity after 60 days. This might be attributed to the substrate utilization by individual and dual inoculants. However by combining three inoculants, a condition of synergism was created that produced greater dehydrogenase activity leading to better and quicker composting process. This is in conformity with the result of Faure and Deschamps, [6].

Table 1. Effect of inoculants on the dehydrogenase activity and C:N ratio

SI. NO.	Treatments	Dehydrogenase activity (mg formazon formed h^{-1} g^{-1})				C:N ratio			
		Composting periods (days)							
		0	30	60	90	0	30	60	90
1	T1 - *Bacillus sp*	1.20	1.92	2.13	1.72	100.65	74.14	43.59	22.84
2	T2 -*Pseudomonas fluorescens*	1.21	1.99	2.33	1.74	100.45	72.36	42.59	21.68
3	T3-*Trichoderma reesei*	1.20	1.97	2.45	1.75	100.80	71.30	40.03	20.86
4	T4-*Bacillus sp* + *P.fluoresecens*	1.20	2.86	3.15	2.33	100.40	64.38	37.84	16.96
5	T5 -*Bacillus sp* + *T. reesei*	1.19	2.72	3.23	2.45	100.93	64.19	33.45	16.38
6	T6 -*P.fluorescens* + *T. reesei*	1.19	2.06	3.15	2.96	100.99	62.77	31.57	15.16
7	T7 - *Bacillus sp* + *P.fluorescens* +*T.reesei*	1.20	3.18	4.10	3.13	100.38	59.67	23.31	10.11
8	T8 - Control	1.19	1.23	1.43	1.20	100.41	83.17	57.22	37.70
	SE CD (p=0.05)	0.02 NS	0.13 0.27	0.09 0.20	0.011 0.23	0.005 0.01	0.61 1.32	0.83 1.79	0.21 0.47

The C:N ratio of the waste is one of the indicators of compost maturity. The C:N ratio of the substrate narrowed down during composting. Initially the C:N ratio of the substrate ranged from 100.30 to 100.99 (Table 1). The decrease in C:N ratio was proportional to the increase in the sampling period. On 60th day, T7 attained a C:N ratio of 23.31 and thereafter stabilized. The dual inoculants treatment required 60 days of composting to attain a C:N ratio of 37.84. On the other hand, single inoculant treatments T1, T2 and T3 require 90 days to attain the ratio of 22.84. A lower C:N ratio of 10-22 is said to be optimum for good quality matured compost. The reduction in C:N ratio was faster upto 60 days of composting and it might be due to the presence of high amount of added nitrogen through urea and also due to the thermophilic conditions with increased microbial activity [7]. The slow reduction of C:N ratio may be attributed to complex nature of lignin content of composting [8].

The suitability of the coir pith waste compost for application to crop plant was tested in vitro using tomato seeds. The compost sample collected at 30, 60 and 90th day of composting was used as supporting medium for the germination test (Table 2). On the 30th day, percentage of tomato seeds increased from 45.00 to 86.00 percent for different treatments and it significantly increased and ranged from 53.00 to 93.00 percent on 60th day. On 90th day, it ranged from 60.00 to 98.66 percent. The consortium composted sample recorded more than 90 percent seed germination on the 60th day itself, while 90 days required for single inoculants compost to attain 90 percent seed germination. The germination test indicated that the compost is free from phytotoxic substances. This was substantiated by Zucooni et al., [9] who reported that compost aeration and turning is the most important factor in the metabolic destruction of phytotoxins.

Table 2. Effect of microbial consortium on the germination percentage

S.No	Treatments	Germination percentage		
		Composting periods (days)		
		30	60	90
1	T1 - *Bacillus sp*	54.00	62.33	94.00
2	T2 -*Pseudomonas fluorescens*	52.00	62.00	93.00
3	T3-*Trichoderma reesei*	55.00	63.66	95.66
4	T4-*Bacillus sp* +*P.fluoresecens*	70.15	80.33	97.66
5	T5 -*Bacillus sp* + *T. reesei*	72.35	83.00	97.00
6	T6 -*P.fluorescens* + *T. reesei*	70.00	83.00	98.00
7	T7 - *Bacillus sp* + *P. fluorescens* + *T. reesei*	86.66	93.00	98.66
8	T8 - Control	45.00	53.00	60.00
	SE CD (p=0.05)	1.12 2.36	1.05 2.17	1.79 3.59

APPLICATIONS

The results are useful for making compost by using coir pith waste.

CONCLUSIONS

The composting technology requires efficient microbial consortia to reduce the composting periods in order to minimize time, cost and management of waste. The technology attempted in the current study included using selected efficient microbes to reduce composting periods. The study revealed that triple inoculants treated sample showed appreciable enzyme activity, reduction in C:N ratio, high non-existence of phytotoxic compound compared to single or dual inoculants.

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