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J. Sci. Trans. Environ. Technov. 2012, 6(1) :6-9

Scientific Transactions in Environment and Technovation

Efficacy of vermicomposted coirpith on the growth of *Abelmoschus esculentus*

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Abstract

An exotic earthworm, *Eudrilus eugeniae* (Kinberg), and an indigenous earthworm *Lampito mauritii* were used to prepare coir pith based compost with different feed ratios. These vermicomposted coir piths were amended with garden soil as a pot medium for the growth of the vegetative plant, *Abelmoschus esculentus* (commonly called Bhendi or Lady's finger). Significant plant growth was attained when the compost prepared by *Eudrilus eugeniae* with equal ratios of coir pith and cow dung amended with garden soil. The results showed that vermicompost prepared in equal ratio with cow dung was significantly superior to all other treatments and recorded the maximum shoot length and weight, root length and weight, number of leaves and flowers,and protein, carbohydrates and chlorophyll content. Growth physiological studies also revealed that compost prepared by the exotic species is more effective than the indigenous and control. Thus it is concluded that composted coir pith based potting medium is the best and perfect growth promoter for cultivation of vegetative plant, *Abelmoschus esculentus*.

Keywords: coir pith, growth physiology, potting medium, vegetative plant, ,vermicomposting

INTRODUCTION

Coir pith or coir dust is a major byproduct of coir fiber extraction industries. Normally coir pith is dumped as agricultural waste and accumulates as heaps of course and fine dust. It is a fluffy, spongy material with significant water holding capacity, and is extremely compressible. In India, an estimated 7.5 million tonnes of coir pith are produced per annum. The coir pith thus produced decomposes very slowly in the soil as its pentosan-lignin ratio is below 0.5, and because of the chemical and structural complexity of its lignin-cellulose complex (Ramalingam *et al.* 2004). Moreover, plant cell-wall lignin is generally synthesized by polymerization of coniferyl, sinapyl and p-coumaryl alcohols to produce large molecules of indefinite size in which aromatic monomers are linked by a variety of chemical bonds. This structural feature has important implications for effective biodegradation by earthworms. Biodegradation of this waste by earthworms is generally considered to be a safe, effective and environmentally friendly process.

Earthworm species such as *Eudrilus eugineae* and *Lampito mauritii* are voracious feeders of organic wastes, and their presence has been found to reduce the time required for composting (Prabha *et al.* 2008). Therefore, in our study we used *E. eugeniae and L. mauritii* in the composting of coir pith. The resultant bio-compost was tested as a growth promoter for the vegetative plant *Abelmoschus esculentus* (commonly called Bhendi or Lady's finger) and also for estimation of the efficacy of composts prepared by both worms. *Abelmoschus esculentus* is a flowering plant in the mallow family. It is valued for its edible green seed pods. Originated in Africa, the plant is cultivated in tropical, subtropical and warm temperate regions around the world. In India it has become the most important vegetative crop.

MATERIALS AND METHODS

Composting process

Coir pith was collected from the coir industry at Kadavasal, 5 kilo meters from Sirkali, Nagapattinam District, Tamilnadu, India. Cow dung was collected from nearby dairy farm. 'Effective earthworm' samples was obtained from vermicomposting unit, Department of Zoology, Annamalai University. The coir pith collected was pre-processed by repeated washing (7 times) to make the resultant coir pith a more suitable substrate for the earthworms. This process also leaches out the excess potassium, calcium, sodium and chloride salts. Two experimental setups were made for this project, one for *Lampito mauritii* (indigenous species) and the other for *Eudrilus eugeniae* (exotic species). The composting units, plastic trays (30 x 20 x 20 cm) were filled with pre-processed coir pith and cow dung, as feed in different ratios (1:1, 2:1, 3:1 and 4:1) keeping the coir pith alone as control. The feed substrate was made up to 1kg (Triplicates). Fifteen exotic and indigenous earthworms were added to the composting units, and were left for 45 days. The bedding was kept moist through-out the experiment by regular watering.

Pot experiment

The seeds of *A.esculentus* were procured from the Agriculture Office, Sirkali, south India. Four ratios of vermicomposted coir pith were compared with control vermicompost obtained from two experiments by pot culturing *A.esculentus*. The composted coir pith was

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mixed with garden soil in 1:3 ratios and then filled in pots. This composted coir pith acts as an effective pot medium as it increases the growth by improving soil pore space, water holding capacity, and nitrogen content (Baskaran and Saravanan 1997). Seeds were sown and the setups in triplicates were kept under natural sunlight and watered daily. After 30 days, measurements were made on the shoot and root length, shoot and root weight, number of leaves and flowers, and contents of carbohydrate (Lee and Tournsean 1958), protein (Lowry et al. 1951), and chlorophyll (Arnon 1949) in the leaf water extracts. Root length was measured from ground level to the tip of the root and shoot length was measured from ground level to the tip of the plant. Fresh weight of the shoot and root were weighed in grams. Number of leaves and flowers were counted manually.

Constituent analysis of coir pith, cow dung and garden soil

Analysis of lignin was carried out by modified Klason lignin assay, cellulose and organic carbon content as described by Updegraff (1969) and Walkley and Black (1934), respectively, N by Kjeldahl method, P by Spectrophotometer and K by Flame photometer. Phenol and reducing sugars were estimated by the Folin-ciocalteu method (Brag and Thorpe 1954) and the DNSA (dinitro salicyclic acid) reagent (Miller 1959) method, respectively.

RESULTS

Lignin, Cellulose, Organic carbon and NPK content of coir pith and cow dung before and after vermicomposting were given in Tables 1 & 2. Lignin and cellulose contents of fresh coir pith were 37% and 35%, respectively. Lignin content decreased from 37% to 21% and 18.3% when treated with earthworms while cellulose content decreased to 3.1% and 2.76%. Vermicomposted coir pith recorded significantly higher organic carbon per cent (41.23%) compared to coir pith (28.3%) and cow dung (32.9%) (Table 2). Phenol was reduced in the vermicomposted coir pith (1.99 mg/gm). Similar findings were recorded for the reducing sugars as well.

The growth physiology observed by pot culturing of A.esculentus has been given in Table 3. Maximum plant growth (shoot length 46.8 cm; root length 26.9 cm), and carbohydrate, protein and chlorophyll contents were achieved in plants grown in soil amended with composted coir pith prepared in 1:1 ratio treated with *Eudrilus eugeniae*. The shoot weights were 21.7gms, 18.7gms, 17.9gms and 17.1gms (Shoot weight) when treated with E.eugeniae composts and 16.6gms, 10.7gms, 11.5gms and 14.6gms when treated with *L.mauritii* compostsin different amendments.

The protein contents observed were 6.28mgs, 6.20mgs, 5.18mgs, and 5.16mg in plants grown in *E.eugeniae*

Table 1: Constituent analysis of raw coir pith, cow dung and garden soil

Samples	Lignin (%)	CHO (mg/g)	Protein (mg/g)	OC (%)	N (%)	P (%)	K (%)	Cellulose (%)	Phenol (mg/g)	RS (ug/g)	C:N Ratio (%)
Raw CP	37	0.35	4.13	28.3	0.68	27.5	0.04	35	6.40	0.0045	54.41
Cow dung	-	0.48	5.67	32.9	1.23	0.31	0.80	1.02	0.15	0.0009	29.96
Soil	-	0.17	1.09	0.68	66.1	14.3	261.5	1.35	1.09	0.0011	0.01

Table 2 . Effects of vermicomposting on biodegradation of organic constituents in coir pith (after 45 days) by *Eudrilus eugeniae* and *Lampito mauritii*

Treatment (CP:CD)	Lignin (%)	OC (%)	N (%)	P (%)	K (%)	Cellulose (%)	Phenol (ug/g)	RS (mg/g)	C:N Ratio (%)
***Eudrilus eugeniae* Treated**									
Control	21	26.71	2.084	0.09	1.94	3.1	2.80	0.0021	12.81
1:1	20	41.23	3.71	0.21	2.35	5.18	2.03	0.0028	11.11
2:1	19	40.43	3.30	0.20	2.31	5.18	2.03	0.0027	12.25
3:1	18	32.71	3.22	0.19	2.25	5.08	2.19	0.0026	10.15
4:1	18	31.89	3.20	0.17	2.23	4.99	2.18	0.0024	9.96
***Lampito mauritii* Treated**									
Control	18.3	20.32	3.26	0.11	1.18	2.76	2.78	0.0019	6.23
1:1	19	36.65	3.71	0.22	2.28	4.99	2.04	0.0027	9.87
2:1	18	31.22	3.62	0.21	2.26	4.35	2.19	0.0027	8.62
3:1	18	29.73	3.38	0.13	2.19	4.02	2.07	0.0026	8.79
4:1	17	21.11	3.27	0.12	2.15	3.69	2.20	0.0024	6.45

Table 3. Effect of vermicompost of *Eudrilus eugeniae* and *Lampito mauritii* on the growth physiology of *A.esculentus* after 30 days

Treated Plants	CHO (mg/g)	Protein (mg/g)	Chloro a (mg/g)	Chloro b (mg/g)	SL (cm)	RL (cm)	SW (gm)	RW (gm)	NOL (Avg)	NOF (Avg)
Eudrilus eugeniae Compost										
Control	0.52	3.15	1.13	0.10	27.3	16.8	10.4	3.8	9.33	3.0
1:1	0.94	6.28	1.34	0.14	46.8	26.9	21.7	5.8	12.3	5.66
2:1	0.68	6.20	1.21	0.12	34.5	24.4	18.7	4.7	11.1	5.0
3:1	0.61	5.18	1.18	0.10	32.6	22.5	17.9	4.6	10.6	4.66
4:1	0.58	5.16	1.09	0.09	30.9	22.1	17.1	4.0	10.0	4.33
Lampito mauritii Compost										
Control	0.49	3.13	1.11	0.09	27.2	11.3	6.83	3.6	5.33	1.3
1:1	0.91	6.26	1.31	0.13	35.5	16	15.6	5.1	8.33	3
2:1	0.65	6.19	1.18	0.11	33.3	14.1	10.7	4.4	8	2.66
3:1	0.61	5.17	1.17	0.09	32.2	13.5	11.5	4.4	7.66	2
4:1	0.53	5.14	1.08	0.08	29.1	12.3	14.6	4.1	7	2

CP – Coir Pith; CHO - Carbohydrates; Chloro a – Chlorophyll a; Chloro b – Chlorophyll b; SL – Shoot Length; RL – Root Length; SW – Shoot Weight(fresh); RW – Root Weight(fresh); NOL – Number of Leaves; NOF – Number of Flowers; Avg – Average;

compost where as 5.26mgs, 5.19mgs, 4.17mgs, and 4.14mgs in *L.mauritii* compost in different amendments. With regard to Carbohydrate, 0.94mgs and 0.91mgs were the highest amount recorded. Increased chlorophyll content was observed in plants treated with 1:1 ratio of both worm's compost (Table 3). High percentage of protein, carbohydrate, and chlorophyll were observed in plants treated with composted coir pith in various ratios than the control. Thus incorporation of cow dung that too in equal ratio with coir pith could be more effective in degradation as well as in plant growth.

DISCUSSION

Composting with earthworms promotes microbial populations by means of both intestinal and vermicast mechanisms. In the process of feeding, earthworms fragment the substrate, thereby increasing its surface area for further microbial colonization (Chan and Griffiths 1988). From the results, an increase in nitrogen and decrease in carbon content was observed in all ratios of composted coir pith. This reduction in C: N ratio resulted from the decomposers using the carbon compounds as their energy source which was found to be enhanced by the addition of cow dung (Dash and Patra 1977). A salient finding observed is that concentration of nitrogen in vermicomposted coir pith increases with increase in cow dung (i.e. maximum in 1:1 ratio than others). In all ratios of vermicomposted coir pith a reduction of lignin and cellulose content was observed which confirms the action of earthworms in degradation of coir pith effectively. There was a definite reduction in organic carbon, phenols and reducing sugar contents of raw coir pith when treated with earthworms.

The pot culture experiment carried out to study the effects of vermicomposted coir pith prepared in different ratios by cultivating *Abelmoschus esculentus* against control showed that plants grown by the application of vermicomposted coir pith in different feed ratios with cow dung by both species of earthworms showed efficient growth than the control vermicompost with only coir pith as substrate. Thus coir pith composted with combination of cow dung provides NPK enrichment on pot culture. In case of protein, carbohydrate and chlorophyll contents, the maximum was observed in plants grown in *E.eugeniae* prepared compost from 1:1 cow dung ratio which indicated the necessity of cow dung incorporation during vermicomposting for the effective yield. Thus the present study confirms that composted coir pith with garden soil is an excellent potting medium for the cultivation of vegetative plant, *Abelmoschus esculentus*.

CONCLUSIONS

Inorganic fertilizers are often added as growth promoters during cultivation of *A.esculentus*. Vermicomposted coir pith provides a good alternative to this. It avoids pollution, improves health and hygiene, and water holding capacity and fertility. Our success with vermicomposted coir pith on the growth physiology of *A. esculentus* suggests that this compost can be used as growth promoter for the production of vegetative plant, *A.esculentus* and possibly for other crops as well. Hopefully this information will encourage small scale producers interested in growing this plant to do so organically, and in economically, and environmentally friendly ways.

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