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USE OF COIR PITH COMPOST AS AN EFFECTIVE CULTIVATING MEDIA FOR ORNAMENTAL, MEDICINAL AND VEGETABLE PLANTS

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ABSTRACT

Coir pith which is considered as a problematic waste in coir fibre extraction units can be converted to effective organic manure with use of fungus (*Pleurotus sajor caju*) and nitrogen fixing bacteria (*Azotobacter vinelandii* and *Azospirillum brasilense*) and which can be used for the cultivation of all kinds of plants. Twenty ornamental, ten medicinal and five vegetable plants were subjected for the investigation. From the studies, it is confirmed that all the plants show enhanced growth in coir pith compost compared with garden soil. The composted coir pith can be used for an effective cultivating media for all kinds of plants including ornamental, medicinal and vegetables. Thus the use of coir pith for cultivation of plants can be entertained in homes, nurseries and fields; thereby minimize the environmental pollution caused by coir pith.

Keywords: Compost, Ornamental Plants, Organic Manure, Carbohydrate, Chlorophyll

INTRODUCTION

Coir pith is known as coir dust and is the major by-product of the coir fiber extraction industries **[1]**. Normally coir pith is dumped as agricultural waste and accumulates as heaps of course and fine dust. After the extraction of coir fibre from the husk it is a ligocellulosic waste material consists of lignin 20 to 40%, cellulose 40 to 50%, hemicelulose 15 to 35% and protein 2.04% **[2]**. Coconut (*Cocos nucifera*) is cultivated in tropical

countries. The fibrous mesocarp of coir is used to make ropes. The waste of coir yarn industry (coir pith) gets accumulated in large quantities making their disposal difficult, though it is used as soil conditioner **[3]**. India is the leading producers of coconut. It is an important oil seed and cash crop grown in south Indian states especially in Kerala, Tamil Nadu and Karnataka.

The plants that concern man can be divided into three general categories: (1) agricultural plants that are grown for food or fiber; (2) weedy plants that grow where they are not wanted; (3) ornamental, or amenity, plants. The latter group is grown mainly for its aesthetic qualities but may have certain secondary benefits such as providing shade, privacy, wind protection, etc. In general, the term "ornamental plant" or "ornamental" is used to describe those species primarily cultivated for their aesthetically-pleasing characteristics such as form, bark, leaves, flowers, fruit or some combination thereof.

In the United States there is currently a growing interest in ornamentals. The expanded use of these plants has caused their cash value to rival, and in some instances exceed, the value of food and fiber crops. In 1984, nursery production in three north-eastern states (Maine, New York and Pennsylvania) accounted for more than $230 million **[4]**; the value of white potatoes in the same three states in 1982 was $188 million (USDC, 1984).

All the experimental medicinal plants are well known for its efficiency for medicinal values. Brahmi (*Bacopa monnieri*), a well known prostrate herb, is distributed in damp, marshy areas throughout India **[1]**. *Piper longum* can be cultivated successfully in organic matter rich fertile well drained forest soils. It is originated in South Asia and is found almost all over India. It is a component of Indian medicine reported as remedy for treating several diseases including gonorrhea, menstrual pain, tuberculosis, sleeping problems, respiratory tract infections, chronic gut related pain, arthritis and alleviation of anxiety **[5]**. *Phyllanthus niruri* originated in India, usually occur as a winter weed throughout the hotter parts. *P. niruri* is a herb of Euphorbiaceae family that grows upto 60 cm. In recent years, more and more people are complimenting their treatment with natural supplements. Kalmegh (*Andrographis paniculata*) as ethanolic extract has an insulin sensitizing effect **[6]**. Coconut coir dust is being marketed as a soilless medium substitute for sphagnum peat moss that inhibits fungus gnat (*Bradysia* sp.) development **[7]**. Several other important studies also conducted on antioxidant activity

of some medicinal plants grown under organic farming conditions **[8]**. Growth of *A. paniculata* in vermicomposted coir pith has suggested that vermicomposted coir pith could be helpful for reclamation of soils from industrial sites for cultivation of *A. paniculata* in a small scale nursery **[9]**. Aqueous extract of leaves of *A. paniculata* has traditionally been used for treatment of various liver disorders and jaundice **[10]**. Vegetable farming is an important cultivation practice of peoples in Kerala. But after several times of cultivation the fertility of soil has been lost due to the reduction of nutrients in the soil. Use of coir pith in soil helps to reclaim the nutrients in the soil and also helpful for enhancing the water holding capacity of the soil.

This study presents the use of coir pith compost with white rot fungus and nitrogen fixing bacteria for cultivation of ornamental, medicinal and vegetable plants.

MATERIALS AND METHODS

Experimental Section

Coir pith was collected from Kalavoor, Alapuzha district, India. Microbial species get from Microbiology division of CCRI, Alappuzha and Agro biotech, Kottayam. Experimental protocol, field experiment and biochemical analysis of coir pith was carried out at School of Environmental Studies, CUSAT and CCRI, Kalavoor.

Composting Process

Two lots of coir pith (1 kg each) in duplicate were laid as separate heaps. *P. sajor caju* (12 g) spawn and N-fixing bacteria (*Acetobactor vilendii and Azospirillum brasilense*) were thoroughly mixed with first lot of coir pith. Second sample was kept as untreated. Moisture content was maintained and study was monitored regularly for 45 days, by drawing out samples at periodic intervals.

Field Experiment

The coir pith compost degraded by *Pleurotus sajor caju, Azotobacter vinelandii* and *Azospirillum brasilense* were compared with control (garden soil). Two sets of 35 pots were used for cultivation of twenty ornamental, ten medicinal and five vegetable plants. Each set of pot was maintained for each species of experimental plant. One plant is cultivated in garden soil and the other is in compost. After 45 days, measurements were made of leaf number, shoot and root length. Aqueous extract of leaf was analyzed for carbohydrate **[11]**, protein **[12]**, and chlorophyll **[13]**.

Constituent Analysis of Coir Pith and Soil

Analysis of lignin was carried out by Modefied Klason Lignin assay, N by Kjel dahl method, organic carbon by Walkey and

Black method, P by Spectrophotometer and K by Flame photometer.

RESULT AND DISCUSSION

Lignin content, organic carbon and NPK of garden soil sample and coir pith before and after decomposition with *P. sajor caju* and N-fixing bacteria were estimated **(Table 1)**. Lignin content of raw coir pith (32%) varied after biodegradation with a combination of organisms [*P. sajor caju* and N- fixing bacteria (*Acetobacter* and *Azospirillum*)]. Decomposition was up to 17% with the combination. *Pleurotus spp*. is known to decompose and utilize various agricultural wastes **[9]**. From current results, an increase in nitrogen component of substrate, and a proportionate decrease in carbon were also observed as also reported in earlier works **[3]**. A salient finding observed is that concentration of nitrogen in spent substrates increased with reduction in C: N ratio25. In all treatments, a reduction was observed of lignin content, which confirms action of microbial agents effectively. There was a definite reduction in organic carbon content of raw coir pith when treated with mushroom and bacteria. The growth physiology observed by the pot/grow bag culturing of all the plants shown in **Table 2-7**. A pot culture experiment was carried out to study effect of coir pith based potting mixture with garden soil on twenty different ornamental plants, ten medicinal plants and five vegetable plants. Maximum plant growth (leaf number, shoot length and root length), carbohydrate, protein and chlorophyll were achieved in plants grown in soil and composted coir pith. In both the samples the control (soil) shows no significant increase in both root and shoot length. But in plants cultivated in composted coir pith there is a definite increase of shoot and root were observed. All kinds of plants including ornamental, medicinal and vegetables were showed enhanced growth in coir pith compost comparing with garden soil. The authors already studied the efficiency in growth of medicinal plants in coir pith compost **[1]**, but the present study show light to the efficiency of all kinds of plants including ornamental, medicinal and vegetable plants growing in coir pith compost. All the twenty plants were grown well in both the samples and the results were tabulated in **Table 2**. In case of ornamental plants; the leaf number is more in plants grown in compost than garden soil. The shoot and root length also show variations. **[14]** observed coir pith showed a spectacular increase of the water holding capacity of the potting mixture when tomato plants on coir pith based potting mixture grown. From the results, it is observed that an increase in nitrogen and

decrease in carbon content was observed in all the samples and this reduction in C: N ratio resulted from the decomposers using *Pleurotus sajor caju* and nitrogen fixing bacteria. A salient finding observed is that the plants grown in coir pith compost is well grown with more lengthy shoots and more number of leaves. This would have confirmed that coir pith compost can be used as an effective potting media for all kind of plants including Ornamental, Medicinal and Vegetables.

The protein content of ornamental plants in the range of 1.39 (*Hibiscus rosasinensis*) to 4.57 (*Fabiana imbricate*) in plants cultivated in soil and it is 3.12 (*Brugmansia suaveolens*) to 5.98 (*Fabiana imbricate*) in plants cultivated in coir pith compost. In case of medicinal and vegetable plants also have no fluctuations in the previous results. Therefore it is confirmed that composted coir pith itself can be used as an effective potting medium for all kinds of plants including ornamental, medicinal and vegetable plants. Carbohydrate and chlorophyll content also show similar variations. It is observed that the amount of carbohydrate is high in plants grown in the coir pith compost while the same in the soil show reduced values. In ornamental plants, *Rhododendron peridymenoides* (0.36 mg/g) shows the highest value of carbohydrates and the lowest one is *Hydechium coronarium* (0.20 mg/g). In case of medicinal plants, *Bacopa monnieri* (0.36 mg/g) have the highest amount of carbohydrate which is grown in coir pith compost and the same in garden soil shows the value 0.26 mg/g. All the medicinal plant shows the carbohydrate content more than 0.30 mg/g while the same plants grown in soil indicate the range of 0.20 mg/g to 0.26 mg/g. There are not many differences in the case of vegetable plants. *Solanum melongata* shows the higher value (0.36 mg/g) of carbohydrate content and the lowest is *Vigna unguiculata* which is cultivated in garden soil. Chlorophyll is one of the important indicator for the growth of plants. Chlorophyll content in the ornamental plants show a definite difference when cultivated in coir pith compost while in comparison there are not much changes during cultivated in garden soil. The chlorophyll content is between 0.16 mg/g (*Hibiscus rosasinensis*) to 0.26 mg/g (*Nyctanthus arbortristis*) in compost and in garden soil it is in range of 0.11 mg/g (*Brugmansia suaveolens* and *Rhododendron peridymenoides*) to 0.20. Almost similar results were reported that high percentage of rooting of acalypha and bougainvillea was observed in coir dust medium when compared to sand or soil+organic manure. In case of

medicinal plants, almost similar kinds of results were observed. The plants grown in the coir pith compost show increased chlorophyll value and the same in garden soil have low values in comparison with compost. Vegetable plants also have no definite fluctuation from the pattern of ornamental and medicinal plants. **[9]** suggested that vermicomposted coir pith with *Eudrilus eugeniae* and *Lampito mauritii* were used to prepare coir pith based compost in different ratios combining with cow dung. They grow *Abelmoschus esculentus* and study their growth physiology such as shoot length, root length, carbohydrate, protein and chlorophyll.

The byproduct of the coir industry, coir pith can be converted to effective coir pith manure by the use of fungus and nitrogen fixing bacteria and use this manure for almost all kinds of plants including ornamental, medicinal and vegetable plants. All the experimental plants such as twenty ornamental, ten medicinal and five vegetable plants were grown in coir pith compost much better than garden soil. Thus the present study confirms that composted coir pith can be used as an effective growing medium for all kinds of plants without the use of garden soil.

CONCLUSION

Coir pith compost is as excellent and eco-friendly option for cultivation of all kind of plants. Composted coir pith based potting medium for cultivation of ornamental, medicinal and vegetable plants suggested that this compost can be used in reclamation of soils for its enhanced production, and also possibly almost all the other crops. This study will encourage those involved in cultivation of ornamental plants in homes and nurseries, cultivation of medicinal plants and vegetables organically, economically and using environmental friendly ways.

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Figure 1: Plants in Garden Soil and Compost Grow Bags

Table 1: Lignin, Organic Carbon and NPK Contents on Garden Soil and Compost

S. No.	Treatment	Lignin (%)		Organic carbon(%)		Nitrogen(%)		Phosphorous(%)		Potassium(%)	
		0 (Days)	45 (Days)	0 (Days)	45 (Days)	0 (Days)	45 (Days)	0 (Days)	45 (Days)	0 (Days)	45 (Days)
1	Garden Soil	-	-	5.98	5.63	0.43	1.08	0.25	0.44	0.056	0.078
2	Composted Coir pith with *P. sajor caju*, *A. vinelandii* and *A. brasilense*	32	17	7.13	6.27	0.44	0.67	0.22	0.52	0.033	0.046

Table 2: Leaf Number, Shoot and Root Length of Medicinal Plants

S. No	Plant Name	Leaf Number						Shoot Length(cm)						Root Length(cm)					
		Soil			Compost			Soil			Compost			Soil			Compost		
		0	30	60	0	30	60	0	30	60	0	30	60	0	30	60	0	30	60
1	*Andrographis paniculata*	8	18	48	10	19	52	10	14	18	10	13	20	6	-	4	6	-	18
2	*Phyllanthus niruri*	11	16	19	11	16	22	10	13	17	11	12	18	8	-	14	7	-	18
3	*Bacopa monnieri*	8	19	30	8	12	31	8	10	12	8	10	12	8	-	13	6	-	15
4	*Piper longum*	6	12	18	7	12	18	10	17	19	10	17	19	6	-	12	8	-	14
5	*Kaempferia galanga*	10	13	16	10	13	19	9	17	18	9	16	20	8	-	12	7	-	15
6	*Vitex negundo*	12	17	19	12	16	20	12	16	19	11	18	22	6	-	14	6	-	14
7	*Eupatorium triplinerve*	11	14	33	12	15	36	12	16	31	12	19	34	6	-	14	9	-	16
8	*Inula recemosa*	11	20	35	10	22	37	11	20	29	12	21	31	5	-	15	6	-	16
9	*Euphorbia nivulia*	6	21	31	6	21	34	12	15	16	13	15	16	8	-	11	5	-	15
10	*Ocimus kiliandscharium*	13	30	40	13	30	41	10	19	41	12	20	42	10	-	12	10	-	14

Table 3: Leaf Number, Shoot and Root Length of Ornamental Plants

S. No.	Plant Name	Leaf Number						Shoot Length(cm)						Root Length(cm)					
		Soil			Compost			Soil			Compost			Soil			Compost		
		0	30	60	0	30	60	0	30	60	0	30	60	0	30	60	0	30	60
1	*Brugmansia suaveolens*	8	20	90	8	28	101	10	16	45	20	21	50	8	-	12	8	-	15
2	*Rhodendron peridymenoides*	9	32	100	9	31	109	9	12	15	8	12	18	7	-	13	6	-	16
3	*Nyctanthus arbortristis*	10	18	48	11	17	52	11	22	34	11	18	35	10	-	11	9	-	15
4	*Dahlia juarezli*	8	43	101	7	42	112	10	19	24	9	14	25	2	-	14	7	-	14
5	*Hydrangea arborescens*	10	16	25	10	15	27	10	18	28	10	21	30	5	-	14	5	-	18
6	*Hydechium coronarium*	6	16	30	6	16	32	5	8	10	5	8	10	5	-	15	6	-	16
7	*Polypodium glycyrrhiza*	7	12	14	6	11	17	11	16	21	11	17	25	6	-	12	8	-	15
8	*Averrhoa bilimbi*	6	14	20	8	14	23	10	15	20	12	17	20	8	-	12	8	-	14
9	*Bellis perennis*	10	25	80	11	25	83	8	11	14	8	12	15	2	-	11	2	-	12
10	*Spathiphyllum wallisii*	7	13	20	7	12	24	5	6	9	5	9	10	5	-	10	5	-	10
11	*Rosa rugosa*	11	16	26	11	16	28	11	16	20	11	14	22	9	-	10	8	-	10
12	*Petunia hybrida*	10	17	22	12	18	26	10	12	14	10	14	16	9	-	11	9	-	18
13	*Brunfelsia australis*	8	15	24	8	15	25	8	14	17	8	15	18	8	-	12	9	-	14
14	*Hibiscus rosasinensis*	10	17	35	10	18	37	10	20	24	11	19	25	5	-	10	5	-	12
15	*Tumera ulmifolia*	10	15	21	10	16	24	9	10	10	9	11	14	6	-	7	6	-	8
16	*Ixora coccinae*	11	20	21	11	20	26	11	31	40	11	30	42	8	-	10	2	-	11
17	*Jasminum officinale*	8	20	40	8	21	42	10	20	29	10	21	31	8	-	10	6	-	13
18	*Fabiana imbricata*	7	17	18	6	18	22	15	30	48	15	26	50	6	-	10	6	-	12
19	*Bauhinia purpurea*	9	13	20	9	13	20	12	18	30	12	21	32	6	-	11	5	-	14
20	*Tabernaemontana divaricata*	10	20	21	12	20	24	10	16	21	10	20	27	8	-	11	9	-	14

Table 4: Leaf Number, Shoot and Root Length of Vegetable Plants

S. No.	Plant Name	Leaf Number						Shoot Length(cm)						Root Length(cm)					
		Soil			Compost			Soil			Compost			Soil			Compost		
		0	30	60	0	30	60	0	30	60	0	30	60	0	30	60	0	30	60
1	*Momordica charantia*	0	18	50	0	20	60	0	92	190	0	98	250	0	-	15	0	-	18
2	*Abelmoschus esculentus*	0	20	50	0	25	52	0	41	90	0	45	98	0	-	11	0	-	16
3	*Lycopersicon esculentum*	0	31	49	0	30	55	0	42	81	0	46	91	0	-	14	0	-	17
4	*Solanum melongena*	0	38	59	0	32	62	0	30	70	0	36	78	0	-	15	0	-	18
5	*Vigna unguiculata*	0	28	55	0	30	58	0	100	180	0	96	180	0	-	11	0	-	18

Table 5: Carbohydrate, Chlorophyll and Protein Content of Ornamental Plants

S. No.	Plant Name	Biochemical Parameters					
		Carbohydrate (mg/g)		Chlorophyll(mg/g)		Protein(mg/g)	
		Soil	Compost	Soil	Compost	Soil	Compost
1	*Brugmansia suaveolens*	0.28	0.30	0.11	0.26	2.41	3.12
2	*Rhodendron peridymenoides*	0.21	0.36	0.11	0.21	3.62	4.95
3	*Nyctanthus arbortristis*	0.23	0.31	0.18	0.25	2.52	4.12
4	*Dahlia juarezli*	0.25	0.35	0.12	0.21	4.53	5.10
5	*Hydrangea arborescens*	0.21	0.29	0.19	0.20	2.41	3.85
6	*Hydechium coronarium*	0.20	0.28	0.20	0.21	4.48	6.90
7	*Polypodium glycyrrhiza*	0.21	0.31	0.18	0.25	3.80	4.79
8	*Averrhoa bilimbi*	0.25	0.30	0.19	0.19	3.56	4.80
9	*Bellis perennis*	0.23	0.28	0.18	0.18	2.14	3.81
10	*Spathiphyllum wallisii*	0.22	0.27	0.18	0.21	2.46	3.78
11	*Rosa rugosa*	0.22	0.30	0.17	0.22	1.45	3.66
12	*Petunia hybrida*	0.21	0.27	0.19	0.19	2.51	2.78
13	*Brunfelsia australis*	0.21	0.28	0.16	0.18	2.47	2.75
14	*Hibiscus rosasinensis*	0.25	0.31	0.15	0.16	1.39	3.85
15	*Tumera ulmifolia*	0.21	0.35	0.18	0.19	3.46	4.90
16	*Ixora coccinae*	0.20	0.31	0.18	0.18	4.56	5.11
17	*Jasminum officinale*	0.26	0.30	0.19	0.21	3.61	4.12
18	*Fabiana imbricata*	0.25	0.30	0.15	0.18	4.57	5.98
19	*Bauhinia purpurea*	0.20	0.22	0.15	0.19	4.51	8.81
20	*Tabernaemontana divaricata*	0.20	0.28	0.15	0.21	4.50	5.40

Table 6: Carbohydrate, Chlorophyll and Protein Content of Medicinal Plants

S. No.	Plant Name	Biochemical Parameters					
		Carbohydrate(mg/g)		Chlorophyll(mg/g)		Protein(mg/g)	
		Soil	Compost	Soil	Compost	Soil	Compost
1	*Andrographis paniculata*	0.20	0.30	0.19	0.25	2.42	4.01
2	*Phyllanthus niruri*	0.21	0.31	0.19	0.21	3.51	4.75
3	*Bacopa monnieri*	0.26	0.36	0.18	0.20	3.46	3.00
4	*Piper longum*	0.25	0.30	0.17	0.26	2.45	2.81
5	*Kaempferia galanga*	0.21	0.35	0.17	0.19	2.49	2.96
6	*Vitex negundo*	0.26	0.31	0.18	0.18	2.46	3.02
7	*Eupatorium triplinerve*	0.25	0.31	0.19	0.21	1.52	3.89
8	*Inula recemosa*	0.22	0.30	0.20	0.21	2.61	4.98
9	*Euphorbia nivulia*	0.21	0.31	0.19	0.19	4.50	5.96
10	*Ocimus kiliandscharium*	0.20	0.32	0.18	0.18	4.40	6.95

Table 7: Carbohydrate, Chlorophyll and Protein Content of Vegetable Plants

S. No.	Plant Name	Biochemical Parameters					
		Carbohydrate(mg/g)		Chlorophyll(mg/g)		Protein(mg/g)	
		Soil	Compost	Soil	Compost	Soil	Compost
1	*Momordica charantia*	0.22	0.31	0.18	0.19	2.32	4.21
2	*Abelmoschus esculentus*	0.22	0.32	0.17	0.18	2.41	4.07
3	*Lycopersicon esculentum*	0.28	0.31	0.17	0.17	3.56	4.10
4	*Solanum melongena*	0.21	0.36	0.17	0.18	3.52	4.00
5	*Vigna unguiculata*	0.20	0.35	0.18	0.19	4.58	5.80