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FEASIBILITY OF SUBSTITUTING COCOPEAT WITH RICE HUSK AND SAW DUST COMPOST AS A NURSERY MEDIUM FOR GROWING VEGETABLE SEEDLINGS

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ABSTRACT
The present study reports the feasibility of partial substitution of coir dust in cocopeat production with sawdust and rice husk as a nursery media. Compost was produced by mixing different ratios of raw coir dust, saw dust and rice husk following ICAR-IIHR protocol. The chemical analysis of compost samples showed that among different treatments, substitution with 25% rice husk i.e.,T5 (75% Raw coir dust + 25% Rice husk) recorded lowest C/N ratio (37.13), phenols and tannins (155 mg/100gm) at 30 days of composting. Further the effect of these composts were studied on germination and survival rate of tomato, chilli, cabbage, cauliflower and brinjal crops along with the application of 5% soil less mycorrhiza in pro trays. The highest germination percentage and seedlings survival were observed in T5 (75% Raw coir dust + 25% Rice husk) in all the vegetables. The study showed that substitution with 25% rice husk produced the best compost for nursery media and produced intact plugs of seedlings of different vegetables compared to other treatments.

INTRODUCTION

A growing medium refers to a substrate or a combination of substrates used for growing seedlings. This growing medium provides plants with mechanical support, water and mineral nutrient for higher growth and development. During the last decades, there is a worldwide expansion of the use of soilless growing media (Raviv *et al.,* 2002) and coco peat is found to be one of the best ingredients in soilless culture medium, replacing sphagnum peat as reported by Hussain *et al.,* (2014) and Pill and Ridely (1998). However the production of cocopeat requires coir pith, a by-product of the coir industry which is not easily available everywhere and transportation from the available places adds more cost to the production. Therefore there is a need to look for the other cheap and locally available materials which can replace or partially replace the requirement of coir pith in nursery media production. One such material is Rice husk, it is a by-product of milling industry and is one of the important agricultural waste material used as a planting medium. The microanalysis of rice husk shows that it contains C (37%), ash (20%) and the main constituents of the ash is SiO (94%). Thus, this raw material can act as a sorbent for nutrients due to its high content from silica (Tran *et al.,* 1999). Sawdust is another substrate widely used as a growth medium component in areas with wood processing industries, it has high moisture retention capacity, rich in plant nutrients and available at low price. The use of these waste materials provides environmental benefits and the impact of residue accumulation is minimized and economically feasible (Apaolaza *et al.,* 2005). The aim of the experiment is to study the feasibility of substituting coir pith with rice husk and saw dust in nursery media production and also to study the effect of these composts on vegetable seedlings along with mycorrhizal inoculation in pro trays.

MATERIALS AND METHODS

Study area

The study was conducted in the Composting area of the Division of Soil Science and Agricultural Chemistry, ICAR- IIHR, Bengaluru. Different mixtures of raw coir dust, saw dust and rice husk (Table 1) were composted using solid state fermentation with Arka fungal decomposer developed by Soil Science division, Indian Institute of horticultural Research (ICAR-IIHR), Bengaluru, Karnataka, India to increase the rate of composting. The different treatments are as follows.

Compost was produced by following the method developed by ICAR-IIHR for cocopeat production (Selvakumar and Rao, 2016). In order to achieve the best treatment combinations, the raw coir dust were replaced with 10%, 25% and 50 % with saw dust and rice husk separately (T1 to T6) and also a mixture of saw dust and rice husk at 10%, 25% and 50 % respectively. These combinations were mixed properly and filled in bags (45cm wide × 45cm height × 75cm long) with alternate layers of urea (7.5 g/kg) and Arka Decomposer, a fungal decomposer (50 gm/kg). Necessary care was taken to maintain the moisture (60%) during the composting process. The composting materials were turned after every 10 days and watered for 30 days (alternate days) to ensure appropriate composting conditions.

Compost Analyses

The compost samples were taken after 30 days of composting for analyses of carbon, hydrogen, nitrogen and sulfur using CHNS (carbon, hydrogen, nitrogen and sulfur) analyser The samples were prepared and weighed (5-10mg) in a tin capsule and analyzed using CHNS elemental analyser (CHNS Elemental Analysis: Elementar, Germany) (Mitra, 2017).

Estimation of Tannin and Phenol content

The tannin and phenol content of the samples were determined by Folin - Ciocalteu method. (Singleton *et al.,* 1999). About 0.1 ml of the compost sample extract was added to a volumetric flask containing 7.5 ml of distilled water and 0.5 ml of Folin - Ciocalteuphenol reagent, 1 ml of 35 % Na_2CO_3 solution and dilute to 10 ml with distilled water. The mixture was shaken well and kept at room temperature for 30 min. A set of reference standard solutions of gallic acid was prepared in the same manner. Absorbance for test and standard solutions were measured against the blank at 725 nm with an UV/Visible spectrophotometer (Singh *et al.,* 2012).

Plant Bioassay

To determine the best compost for nursery media and to evaluate the effect of mycorrhizal inoculation on vegetable seedlings in portrays, all the nine compost samples were treated with 5% soil less mycorrhiza (cocopeat based - a mycorrhizal consortium consisting of three different *Glomous spp.* of mycorrhiza) developed by IIHR. Five vegetable crop seeds tomato, chilli, cauliflower, cabbage and brinjal were obtained from seed production unit of IIHR, Arka fermented cocopeat collected from division of Soil Science and Agricultural Chemistry, IIHR and used as a standard check for our treatments. The germination percentage, the survival rate of seedlings (%), height (cm), and diameter (mm) of seedlings were recorded.

Table 1: Treatment details of composting

T1	90% Raw coir dust + 10% Saw dust
T2	75% Raw coir dust + 25% Saw dust
T3	50% Raw coir dust + 50% Saw dust
T4	90% Raw coir dust + 10% Rice husk
T5	75% Raw coir dust + 25% Rice husk
T6	50% Raw coir dust + 50% Rice husk
T7	90% Raw coir dust + 10% SR (saw dust and rice husk)
T8	75% Raw coir dust + 25% SR (saw dust and rice husk)
T9	50% Raw coir dust + 50% SR (saw dust and rice husk)

***SR: Saw dust and Rice husk**

RESULTS AND DISCUSSION

Compost Properties

Chemical properties of a substrates plays very important role in characterizing the substrate suitability for seedlings production. Panj *et al.,* (2014) found that the different growing media parameters such as water holding capacity, pH, EC, Organic carbon content (%), available N,P, K (%) content, and growing media respiration has significant effect on growth, quality and yield of gerbera parameters. In our study we have analysed chemical properties using CHNS analyser.

Figure 1: Composting of raw coir dust, saw dust and rice husk in bags

Table 2: Chemical analysis of compost samples

Treatments	Tannin and phenol (mg/100g)	C (%)	H (%)	N (%)	S (%)	C/N
T1: 90% Raw coir dust + 10% Saw dust	1158	50.4	6.4	1.24	0.35	40.58
T2: 75% Raw coir dust + 25% Saw dust	750	48.9	5.9	0.90	0.24	54.33
T3: 50% Raw coir dust + 50% Saw dust	753	43.2	5.7	0.69	0.23	62.60
T4: 90% Raw coir dust + 10% Rice husk	197	35.2	4.2	0.84	0.23	44.00
T5: 75% Raw coir dust + 25% Rice husk	155	36.8	5.1	0.96	0.23	37.13
T6: 50% Raw coir dust + 50% Rice husk	239	39.0	5.0	1.05	0.27	38.12
T7: 90% Raw coir dust + 10% SR	354	36.2	4.3	0.90	0.30	40.01
T8: 75% Raw coir dust + 25% SR	327	34.1	4.4	0.80	0.20	42.47
T9: 50% Raw coir dust + 50% SR	332	35.6	4.6	0.79	0.20	45.08
S.Em ±	5.00	0.60	0.51	0.05	0.10	0.50
CD @ 1%	16.50	2.00	1.50	0.20	0.28	2.00

SR: saw dust and rice husk

T1 (90% Raw coir dust + 10% Saw dust)

T4 (90% Raw coir dust + 10% Rice husk)

T5 (75% Raw coir dust + 25% Rice husk)

Control

Table 3: Seed germination (%) and survival rates (%) of vegetable seeds in different composts

Crop and Period	Treatment name	T1	T2	T3	T4	T5	T6	T7	T8	T9	*AFC
Tomato [21 days]	Germination	98.95	89.56	70.83	88.54	97.35	94.27	97.91	97.39	95.31	96.35
	Survival rate	95.00	86.00	68.00	85.00	93.50	90.50	94.00	93.50	91.50	92.50
Chilli [30 days]	Germination	94.27	-	-	95.83	96.87	-	78.12	79.68	-	95.80
	Survival rate	90.50	-	-	92.00	93.00	-	75.00	76.50	-	91.97
Cauliflower[20 days]	Germination	97.91	-	-	94.27	98.69	-	-	-	-	97.88
	Survival rate	94.00	-	-	90.50	94.75	-	-	-	-	93.97
Cabbage[20 days]	Germination	-	-	-	86.1	98.73	-	-	-	-	95.78
	Survival rate	-	-	-	82.7	94.79	-	-	-	-	91.95
Brinjal[30 days]	Germination	61.22	81.51	68.75	71.61	86.97	75.00	48.43	82.53	84.11	86.37
	Survival rate	58.78	78.25	66.00	68.75	83.50	72.00	46.50	79.25	80.75	82.92

*AFC - Arka fermented cocopeat [All the treatments were inoculated with 5 % soil less mycorrhiza]

related to CHNS, tannin and phenol contents in the nine compost samples after the composting period is presented in Table 2. The C/N value of compost sample showed that five composts had C: N ratio of <40% and the remaining had C:N above 40%. Treatments containing sawdust have shown higher C:N ratio, tannin and phenols compared to rice husk composts. It is perhaps the tannins and phenols in sawdust have not undergone effective degradation during the period of composting and may require further incubation period for reducing the C:N ration and to detoxify the tannins and phenols.

Seed germination and survival rates

Effect of different growing media on growth and yield of horticultural crops were investigated by several workers (Tariq *et al.,* 2013; Tehranifar *et al.,* 2007; Alzrog *et al.,* 2013; Manha and Wang, 2014; Nair and Bharathi, 2015). In our study seed germination and survival rate of vegetable seedlings were studied independently in five experiments in all the composts along with mycorrhizal inoculation and compared with normal AFC (Arka Fermented Cocopeat). The survival rates were interpreted as an indicator of the quality of the compost (Table 3). Percentage germination of seeds varied both with composts and with crop. Brinjal and tomato seeds germinated and survived very well in all the composts. But the performance was not good in composts containing sawdust. Generally substitution of coir dust with saw dust has hindered both germination and survival of seedlings. This is because of high tannins and phenols present in saw dust (Table 1). Not only the total quantity that mattered but also the type of tannins and phenols present in sawdust harmed germination of seeds and also seedling survival. The period of composting perhaps was not sufficient to degrade these harmful tannins and phenols from sawdust. Chili, cabbage and cauliflower did not germinate well and showed poor seedling survival in composts containing sawdust. Similar results were observed by Nagaraj *et al.,* (2015) who evaluated different soil less growing media like cocopeat, rice husk, sawdust, Cocopeat + vermi compost (1:1), Rice husk + vermi compost (1:1), Sawdust + vermicompost (1:1) and sandy loam soil on growth and yield of Bell pepper and found lowest yield in saw dust compared to other treatments. The performance of all the vegetable seeds germination and survival rate of seedlings were best recorded in T5 (75 % coir dust + 25% rice husk compost enriched with soil less mycorrhiza @5%) followed by T4 (90% Raw coir dust + 10% Rice husk compost enriched with soil less mycorrhiza @ 5%) compared with AFC check. As seen in Table 2 the tannins and phenols in these composts were lower than those composts containing sawdust. Hence the performance in these composts were better. Based on these studies Compost T5 (75% Raw coir dust + 25% Rice husk) has outperformed over T4 (90% Raw coir dust + 10% Rice husk) and even performed slightly better than AFC check in terms of compost maturity and seedling survival rate. Cucumber plants were grown in twenty five combinations of peat moss, vermiculite, composted sawdust and crop residues compost (Sawan *et al.,* 1999); the highest plant growth and subsequently the highest yield were obtained by reducing peat moss volume from 50% to 20% in the mixture. Similarly Marjenah *et al.,* (2016) found the best height increment on the combination media of 80% top soil + 20% Biochar (rice husk) in seedlings of *D. aromatica* while the seedlings of *S. balangeran* the best height increment on the combination media of 80% top soil + 20 % coco peat. Mori and Marjenah (1994) also observed increase in height of *Dipterocarpaceae* seedlings due to the use of charcoaled rice husks and forest top soils which possesses mycorrhizal inoculum as a nursery medium.

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