



Original Research Article

Composting of Areca nut leaf sheath and its effects on growth and biochemical contents of *Vigna unguiculata L.*

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Landfills and incineration have until now been the most widely used means of solid waste disposal throughout the world. The land filling of biodegradable waste is proven to contribute to the environmental degradation, mainly through the production of highly polluting leachate and methane gas. A large amount of Areca nut leaf sheath waste was dumped by the areca nut plate manufacturing industry. Thus the present investigation was carried out to find out the sustainable technology to make wealth out of waste. Therefore, five different composts were developed with the combinations of soil, areca nut waste, effective microbes, vermicompost and studied their nutrient value as an organic manure using *Vigna unguiculata L.* Several physicochemical parameters such as pH, C/N ratio, protein, carbohydrate, and chlorophyll are studied after compost maturation. Among five different combinations of compost, S₄ (Areca nut + soil) compost shows the following parameters: pH: 5.4, C/N ratio (24.8:1), chlorophyll (3.002mg/g), carbohydrate (3.21µg/mg), and protein (13.95µg/mg).

Key words: Areca nut leaf sheath waste, organic recycling, *Vigna unguiculata L.*

INTRODUCTION

Environmental degradation is a major threat confronting the world, and the rampant use of chemical fertilizers contributes largely to the deterioration of the environment through depletion of fossil fuels, generation of carbon dioxide (CO₂) and contamination of water resources. It leads to loss of soil fertility due to imbalanced use of fertilizers that has adversely impacted agricultural productivity and causes soil degradation. Now there is a growing realization that the adoption of ecological and sustainable farming practices can only reverse the declining trend in the global productivity and environment protection (Aveyard 1988, Wani and Lee 1992, Wani et al. 1995). There is an imbalance of nutrients distribution because; on one hand tropical soils are deficient in all necessary plant nutrients and on the other hand surplus of large quantities of nutrients. It is estimated that in cities and rural areas of India nearly 700 million tonnes organic waste is generated annually which is either burned or land filled (Bhiday, 1994). Such large quantities of organic wastes generated also pose a problem for safe disposal. Most of

these organic residues are burned currently or used as land fillings. In nature's laboratory there are a number of organisms (micro and macro) that have the ability to convert organic waste into valuable resources containing plant nutrients and organic matter, which are critical for maintaining soil productivity. Microorganisms and earthworms are important biological organisms helping nature to maintain nutrient flows from one system to another and also minimize environmental degradation.

Solid waste disposal has become major problem recently due to shortage of dumping site and strict environmental laws. One such solid waste is the "Areca nut leaf sheath". Normally these agricultural wastes are dumped and become accumulated as a waste product in the form of heaps of coarse and fine dusts. These solid wastes have conventionally been disposed off mostly by burning, that results in various environmental problems including carbon deposits as well as warming of the atmosphere. As a result, emphasis is now on aerobic composting on converting waste into organic

manure rich in plant nutrients and humus.

On an average, 5-5.6 tones of organic waste/ha/yr will be available in areca nut garden. Direct recycling of these wastes for the crop improvement is a time consuming process. Hence composting technique is proved to be an efficient method to meet the demand of nutrients in soil (Central plantation crops research institute (ICAR) – kasaragod, Calicut). Thus the present study aims in composting the areca nut leaf sheath using effective microorganisms and its effect on the plant's growth.

MATERIALS AND METHODS

Areca nut leaf sheath, an agro waste were collected from Sun Areca nut food plates, Kannampalayam, Coimbatore. The samples were made in to pieces and air dried for 3 days and powdered.

Compost Making

The compost was made into six different combinations S₁, S₂, S₃, S₄, S₅ and Control. The experiments were conducted with the duration of 30 days

Various combinations used for Compost Making:

Compost I: (S₁) – 50 % Areca nut waste + 40% Vermicompost + 10% EM (effective microorganism)

Compost II : (S₂) – 50% Areca nut waste + 50% Vermicompost

Compost III: (S₃) – 70% Areca nut waste + 25% Soil + 5% EM

Compost IV : (S₄) – 50% Areca nut waste + 50% Soil

Compost V: (S₅) – 100% Areca nut waste only

Control : (S₆) – Soil

Pre-composting of Areca nut using Effective Micro organisms (EM)

The EM was obtained from Sri Ram Biotech Centre, Madukkarai, Coimbatore (Tamil Nadu), India. Prior to this usage, the EM was activated by mixing one litre of EM with 20 litres of water and 20kg of jaggery. It was stored away from sunlight at room temperature (25±20°C) for a week. The gas formed was released every day until fermentation was completed. Then one litre of activated EM was diluted using 30 liters of water to obtain the EM solution.

Vermicompost

The earthworms used for vermicomposting were *Eudrillus eugeniae* and *Eisenia foetida* that was procured from Tamil Nadu Agricultural University (TNAU) Coimbatore, Tamil Nadu.

Estimation of total nitrogen

The samples were digested with acid and the total nitrogen in the sample was estimated with Nitrate test Kit (MQuant™) following the manufacturer instructions.

Estimation of organic carbon

Accurately measure 10g of sample dried in oven at 105°C for 6 hours in a pre-weighted crucible. The material was ignited in a muffle furnace at 650°C to 700°C for 6-8 hrs. This was cooled and weighed.

Calculation

Calculate the total organic carbon by the following formula.

$$\text{Total organic matter \%} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Weight of sample taken}}$$

$$\text{Total carbon \%} = \frac{\text{Total organic matter}}{1.724}$$

Determination of C: N ratio

The composted Areca nut obtained from different treatments was used to find the C: N ratio (dividing organic carbon by nitrogen content of the sample).

Influence of different combinations of compost on growth and yield of *Vigna unguiculata L.*

The effect of these combinations of compost on the growth and yield of an economically important plant *Vigna unguiculata L.* was studied by conducting pot experiment

Assessment of different parameters on plants

The following parameters were studied in the plant such as shoot length, root length, chlorophyll content of the leaves (Arnon, 1949), carbohydrate and protein content of the leaves (Saasivam and Manickam,1996).

RESULTS AND DISCUSSION

All the experimental setup was given the same environmental conditions. The effect of different treatments on composting was studied using the experiment crop *Vigna unguiculata.L* and the results were recorded periodically. The growth parameters such as, height of shoot, root and diameter of roots were recorded. For first 3 weeks there was no significant difference in the growth of *Vigna unguiculata.L* except the vermicompost mixture and soil mixture (control). 4th week there was a sudden change in the growth of *Vigna unguiculata.L* in arecanut compost, which shows higher values than that of other composts and control. This is due to the fact that during the composting process of wastes by microbes, many of the nutrients changed to forms more

Table 1. Effect of Arecanut waste on the root length and shoot length *Vigna unguiculata* L. (after 30 days)

S.No	Samples	Shoot length(cm)	Root length(cm)
1.	S ₁	28.00 ± 0.10	10.00 ± 0.50
2.	S ₂	20.00 ± 0.27	5.00 ± 0.10
3.	S ₃	18.00 ± 0.04	6.50 ± 0.40
4.	S ₄	29.00 ± 0.02	8.00 ± 0.5
5.	S ₅	10.00 ± 0.50	4.00 ± 0.15
6.	S ₆	26.00 ± 0.12	7.00 ± 0.05
	SEd	0.1970	0.2779
	CD P<0.05	0.4292	0.6055

Values are mean ± SD of six samples in each group

Table 2. Effect of different samples on the macronutrients for compost making

S.no	Nutrients	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆
1.	Nitrogen%	1.40	1.86	1.68	1.46	0.50	0.90
2.	Phosphorus%	0.51	0.46	1.45	0.54	2.50	0.20
3.	Potassium%	0.43	1.18	1.32	1.11	1.80	0.93

Table 3. Comparison of carbon, nitrogen and C: N ratio of different sample for compost making

S.No	Samples	pH	Carbon %	Nitrogen %	C:N ratio
1.	S ₁	8.2	25.29	0.86	29.4:1
2.	S ₂	8.6	22.4	0.67	33.4:1
3.	S ₃	6.2	20.12	1.05	19.1:1
4.	S ₄	5.4	36.35	1.11	24.8:1
5.	S ₅	6.2	24.2	0.37	65.4:1
6.	S ₆	7.8	12.15	0.96	12.6:1

readily taken up by plants such as nitrate, exchangeable phosphorous and soluble potassium, calcium and magnesium (Edwards and Lofty, 1980).

The present study reveals that the organic source present in the areca nut leaf sheath was broken down into nutrients with the help of microbes present in the soil compost S₁ than that of the effective microbes added externally in the treatment S₃. Also the present study indicates that there was no synergistic effect between the soil microbes and EM solutions was also proved and shown in Table 1.

In contrary we can say that after noticing the result of compost C, there may be some antagonistic effect among the soil microbes and the EM solutions. Similarly, after 12 weeks of composting period there was a considerable increase in the N, P, and K contents among the different treatments of coir pith compost was reported by Muthurayar and Dhanarajan (2013). Kadalli et al (2000) was also observed highest N and P contents in coir pith composted with Pleurotus, cow dung, garden weeds, sun-hemp, rock phosphate and micronutrients. In the present study, there was a significant changes observed in the length of root, shoot and diameter of the *Vigna unguiculata* L in the compost treatment S₄ than that of other composts. Also the nearest

value was observed in the treatment S₁ and S₃ due to the presence of both vermicompost, EM and areca nut.

Biochemical composition of different treated composts of areca nut waste alone and combination of EM, Vermicompost with soil was evaluated and presented in (Table 2 and 3).

Changes in the different biochemical constituents such as C: N ratio and pH was recorded at the end of 4th week. The pH of the compost was in range of normal areca nut leaf sheath. After composting the order of pH was found to be compost S₂ > compost S₁ > Soil alone > compost S₃ > Compost S₅ > Compost S₄. The effect of compost with respect to pH was studied and the acidic pH 5. 4 of Compost S₄ (Areca nut +soil) shows higher yield of C/N ratio, chlorophyll content, protein and carbohydrate (Table 3 and 4). Similarly, Prabha et al., (2013) reported the coir pith compost pH -5.47 shows higher yield than the other composts. C/N ratio was also calculated in different composts treated as per C/N ratio calculator (cwmi@cornel.edu) and the results were recorded. The results obtained for its C/N ratio from each compost of S₁, S₂, S₃, S₄ & S₅ are 29.4:1 C/N ratio, C/N ratio 33.4:1, C/N ratio 19.1:1, C/N ratio 24.8:1 and C/N ratio 65.4:1. In Control the C/N ratio is 12.6:1. C: N ratio, macronutrients levels of the composted Areca nut leaf sheath waste. It is obvious that the

Table 4. Effect of Areca nut waste on chlorophyll, Carbohydrate and Protein content of *Vigna unguiculata* L.

S.No	Sample	Chlorophyll (mg/g-660nm)	Carbohydrate (µg/mg-630nm)	Protein (µg/mg595nm)
1	S ₁	2.783	2.63	8.5
2	S ₂	0.162	5.15	10.49
3	S ₃	0.308	2.73	10.40
4	S ₄	3.002	3.21	13.95
5	S ₅	0.301	1.81	11.54
6	S ₆	0.783	2.89	8.45

compost treatment with (S₄) was found to be beneficial and reasonable in their C: N ratio ≥ 25 (24.8:1) and however the control (S₆) gave the ratio of (12.6:1) and the pH is 7.8. The pH was found to be acidic in the treatment S₄ is 5.4 Protein and carbohydrate content of the leaf samples were evaluated along with control.(Table 4)

The results of protein and chlorophyll of compost S₄ showed higher value, (Chlorophyll-3.002µg/mg at 660 nm, Protein-13.95µg/mg and Carbohydrate- 3.21µg/mg). Thus the result indicated the enhanced growth and yield of the plant *Vigna unguiculata* L. And the moderate value observed in compost S₁ & S₂. But the carbohydrate content was higher in the compost S₂, considering the reduction of carbon and increase in the percentage of nitrogen (Prabha et al., (2013), it can be concluded that's compost S₄ (areca nut wastes with soil) was more efficient

Conclusion

The present study reveals that the organic sources present in the areca nut leaf sheath was broken down into nutrients with the help of microbes present in the soil. The areca nut compost contains substantial amounts of plant macro-nutrients such as total N, available P, and K. The amount of NPK present in the compost when added to soil of low inherent fertility will increase the soil organic matter, conservation of soil and water. To reduce the need for inorganic fertilizers the present study will be utilized for making organic compost in an eco-friendly manner. Therefore this compost can be recommended for field application to the farmers to increase the crop yield. Further, farmers can also be trained for making such type of organic compost for the better yield of crop as well as soil productivity.

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