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Utilization of Thermochemical Digestate Fertilizer from Food Waste as Potting Mixture in Polybag Raised Coconut Seedlings (*Cocos nucifera* L.) and its Implication on Seedling Characters

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A B S T R A C T

An experiment was conducted to evaluate the effect of thermochemical digestate fertilizer obtained from food waste after fortification with organic and inorganic sources of fertilizers on seedling vigour, germination percentage, collar girth, seedling weight, seedling height, and the number of leaves in coconut seedlings. Various treatment combinations with thermochemical digestate fertilizer (TCDF), farmyard manure, vermicompost, sand, and soil were conducted in farmers' nurseries in Onattukara region, Kerala. The results of the experiment conducted showed the potting mixture containing two parts sand and one part TCDF was on par with a potting mixture containing soil, sand and TCDF in the ratio 1:1:1 and produced significantly higher number of leaves and a higher percent of seedlings with z score more than 22. The treatments that received TCDF were superior in terms of plant height and collar girth of the seedlings due to the increased nutrient uptake. The treatments with TCDF also recorded the highest number of thick roots. The potting mixture containing sand and vermicompost in the ratio 3:1 was comparable with sand and TCDF in the ratio 3:1. The higher performance and seedling vigour was obtained in treatments that contained TCDF due to sustained nutrient availability from both organic and inorganic nutrient fractions available in TCDF.

Introduction

Coconut (*Cocos nucifera* L) is considered to playa significant role in maintaining the agrarian economy of India. Coconut finds day-to-day utility, ranging from culinary to medicinal and infrastructure, and hence the name "Kalpa Vriksha" meaning the tree of life. Since coconut is a plantation crop with an economic life of more than 25 years, the yield and performance depend upon the variety and the quality of the planting material used. Therefore, great thrust is given in the selection of mother palms from which seed nuts are collected. The collection of seed nuts from the mother palm is done by harvesting the bunches and lowering the bunches using ropes (KAU POP, 2016).

The collected seed nuts are then stored in partially shaded conditions for 60 days. After the removal of malformed nuts, seed nuts are

raised in nurseries. The seed nuts are either raised in nursery beds or the sprouts are transplanted into poly bags. The raising of seedlings in poly bags has proved to increase the seedling vigour due to the intensive care and better root development that reaches the reproductive stage faster than the coconut seedlings transplanted from nursery beds (Krishnakumar and Reddy, 2006).

Conventionally coconut seedlings are grown in poly bags filled with a potting mixture containing sand soil and farmyard manure in the ratio 1:1:1. The potting mixture can also be prepared by mixing topsoil and sand mixture in a 3:1 ratio. Potting media with soil, sand, or coir dust and cattle manure in the ratio 3:1:1 is also common in practice. A study done on alternate potting mixtures for raising poly bag seedlings of coconut showed that a mixture of sand and vermicompost in 3:1 ratio or sand along with P, K fertilizers (15 g / bag) with bio-fertilizer had similar in response to conventional potting mixtures (Reddy *et al.*, 2001).In an experiment, the transplanted seed nuts growth was equally good to the conventional method when river sand was used instead of topsoil in the ratio 3:2:1with cow dung and coir dust (Perera *et al.*, 1996).

The rapid unplanned urbanization with waste management strategies outpaced by the ever-increasing population is causing piling up of waste in developing countries. The major portion of waste generated is degradable that can be converted to quality compost.

But, the time required for the bioconversion process poses handling problems. In this situation, a rapid thermochemical process of waste conversion (process patented), to produce quality compost within8 to 14 hours can overcome this menace (Sudharmaidevi *et al.*, 2017). The developed rapid thermochemical digestate fertilizer, when used in banana Nendran variety and vegetables instead of farmyard manure or cattle manure, increased the yield and yield attributes (Leno and Sudharmaidevi, 2018).

The use of thermochemical digestate fertilizer was attempted in coconut (*Cocos nucifera* L.) seedlings to study the effect on germination, seedling characters and seedling vigour.

Materials and Methods

The experiment was designed in a completely randomized design and carried out in a nursery in farmer's fields in the Onattukara region, Kerala, India from 2016 to 2017. Seed nuts were collected from West Coast Tall (WCT) palms of more than 20 years of age. Seed nuts were collected during February to March 2016 and heaped in the partially shaded condition in a storehouse.

After two months the seed nuts of uniform size and weight were selected for sowing directly into poly bags. Each treatment had three replications with 10 seed nuts sown per treatment and the average was recorded for each parameter. Poly bags of size 45 X 45 cm and 500 gauge thickness were filled with a 10 kg potting mixture. Six different combinations of the potting mixture were tried with combinations of thermochemical digestate fertilizer (TCDF) sand, soil, farmyard manure and vermicompost. The experiment details are as given

T1: Soil + sand + TCDF (1:1:1)

T2: Sand + TCDF (3:1)

T3: Sand +TCDF (2:1)

T4: Sand + Vermicompost (3:1)

T5: Soil + sand + Vermicompost(1:1:1)

T6: Soil + sand + FYM (1:1:1)

Germination percentage was taken 6 months after sowing. The collar girth, plant height number of leaves, number of thick roots, and fresh seedling weight were taken 12 months after sowing in poly bags. The seedling vigour was calculated using the z score (Kumar *et al.*, 1991). The seedlings per treatment that had a z score of more than 22 were expressed in percentage.

Statistical analysis

All data of poly bag experiment was analyzed using the Data analytical package (OP STAT-Statistical software package for agricultural research workers, Hisar, 1998) applying the techniques of analysis of variance. The F values for treatments were compared with the table values. If the effects were significant, critical differences at the 5% significance level were calculated for effecting comparison among the means.

Results and Discussion

The germination percentage was taken at 6 months after sowing. The germination percentage was more than 80% in all the treatments. There was no significant effect of treatments on the germination percent of seedlings as given in Table 1. The collar girth, seedling height, and the number of leaves were significant at $p \leq 0.05$.The Collar girth was significantly high in treatments T1and T3 as given in Table 2. The collar girth was comparable in treatments that received 3:1 ratio of sand: vermicompost and sand:TCDF. The seedling height also showed a similar trend where T1 and T3 were comparable and higher than T2, T4and T5. The seedling height of the treatment that received soil sand and farmyard manure was only 120.5 cm that was the lowest among the treatments. The number of leaves in treatments T1, T2, T3 and T4 were comparatively higher than the treatment that received treatments T5 and T6 as given in figure (1). The treatment T5 that received vermicompost in the ratio 1 (Soil): 1 (Sand): 1 (vermicompost) had a higher number of leaves compared to the farmyard manure (6.6).

The seedling weight didn't vary significantly between treatments that received TCDF and vermicompost as in Table 3. The lowest seedling weight was registered for treatment that sand, soil, and farmyard manure in the ratio 1:1:1. The treatment that received soil, sand and TCDF had slightly higher seedling weight than the treatment that received vermicompost in the same ratio. The number of thick roots was highest (14.23) in the treatment that received sand and TCDF in the ratio 2:1. The treatment that received sand, soil, and TCDF in the ratio 1:1:1 was equally high as in T3. The treatments that received sand and TCDF, sand and vermicompost, sand soil and vermicompost have thick root numbers that were comparable and higher value than the conventional method of 1:1:1 ratio of soil, sand, and farmyard manure.

The percentage of seedlings having Z score of more than 22 is considered to be high-yielding vigorous seedlings that was above 50% in all the treatments as given in Table 4.The highest z score of 61.67 % was recorded in T3 that received sand and TCDF in the ratio 3:1

The germination of coconut seed nut was not much affected by the treatments since the initial germination process is dependent on coconut varietal variation, whether it is slow germination or fast germinating (Harries, 2012). The climatic factor is also associated with the days to germination. Germination is faster in warm and humid conditions. The germination percentage was above 80 % in all the treatments, but germination was slightly higher in the treatment that received TCDF due to higher amount of nitrate forms of nutrients present in the potting mixtures with TCDF.

Table.1 The effect of potting mixtures on germination %

Treatment	Germination %
	Mean
T_1	83.5
T_2	84.7
T_3	84.2
T_4	83.8
T_5	83.3
T_6	83.2
C.D(0.05).	N/A

T1: Soil + sand + TCDF (1:1:1)T2: Sand + TCDF (3:1)T3: Sand +TCDF (2:1)T4: Sand +Vermicompost (3:1)T5: Soil + sand +Vermicompost (1:1:1)T6: Soil +sand + FYM (1:1:1)

Table.2 Effect of treatments on the seedling characters

Treatment	Collar girth (cm)	Plant height(cm)	Number of leaves
T_1	11.7^a	131.5^a	8.3^a
T_2	11.1^b	126.0^b	7.9^a
T_3	11.8^a	133.1^a	8.7^a
T_4	11.2^b	124.3^b	7.8^a
T_5	10.8^b	121.6^b	6.7^b
T_6	10.5^c	120.5^c	6.6^b
C.D(0.05)	0.4	4.8	0.5

Values with same superscript doesn't vary significantly
T1: Soil + sand + TCDF (1:1:1)T2: Sand + TCDF (3:1)T3: Sand +TCDF (2:1)T4: Sand +Vermicompost (3:1)T5: Soil + sand +Vermicompost (1:1:1)T6: Soil +sand + FYM (1:1:1)

Table.3 Effect of potting mixtures on weight of seedling and number of roots

Treatment	Weight of seedling	Number of thick roots
T_1	1.807^a	13.87^a
T_2	1.780^a	12.93^b
T_3	1.810^a	14.23^a
T_4	1.763^a	12.60^b
T_5	1.600^b	12.17^b
T_6	1.573^b	11.90^c
C.D(0.5)	0.093	0.739

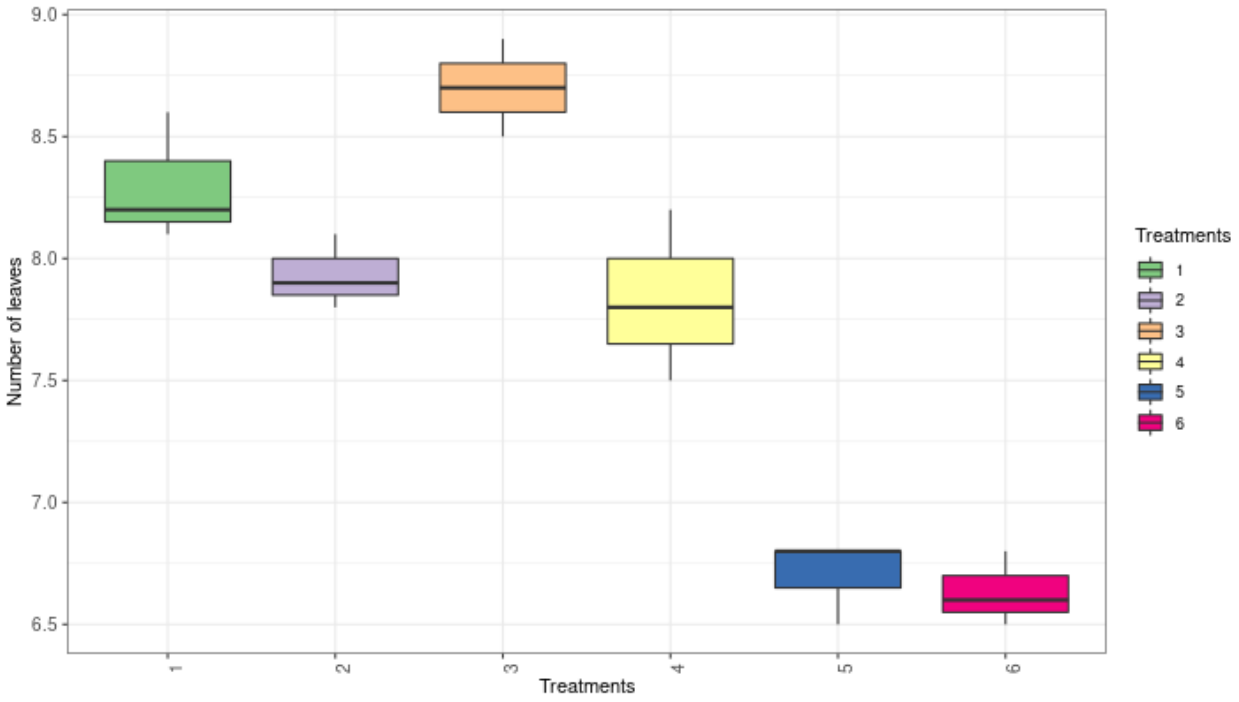
Values with same superscript doesn't vary significantly
T1: Soil + sand + TCDF (1:1:1)T2: Sand + TCDF (3:1)T3: Sand +TCDF (2:1)T4: Sand +Vermicompost (3:1)T5: Soil + sand +Vermicompost (1:1:1)T6: Soil +sand + FYM (1:1:1)

Table.4 Potting mixture effect on percentage seedlings with Z score more than 22

Treatment	Seedlings with Z score more than 22 (%)
T_1	59.93[a]
T_2	56.96[b]
T_3	61.67[a]
T_4	56.38[b]
T_5	51.43[c]
T_6	50.50[c]
C.D(0.05)	2.10

Values with same superscript doesn't vary significantly
T1: Soil + sand + TCDF (1:1:1)T2: Sand + TCDF (3:1)T3: Sand +TCDF (2:1)T4: Sand +Vermicompost (3:1)T5: Soil + sand +Vermicompost (1:1:1)T6: Soil +sand + FYM (1:1:1)

Fig.1 Coconut leaf number



The nitrate forms of fertilizers in form of potassium nitrate enhanced the germination percentage and resulted in early germination in coconut(Thomas,1974).The collar girth of seedling was significantly high in treatment that received sand and TCDF in the ratio 2:1 and treatment that received soil, sand, and TCDF in the ratio 1:1:1. The collar girth increased in treatment that received TCDF due to sustained nutrient availability all throughout the period of establishment. The application of compost increases the population of beneficial microorganisms in the soil that increases seedling vigour (Mantiquilla *et al.*, 1994). The TCDF is formulated by fortification with nutrients from organic and inorganic sources. The nutrients from inorganic sources are easily available and aids in growth during the

initial stages similar results were given by Parwaiz *et al.,*(2014).The sustained nutrient availability will have maintained by the slow release of nutrients from the organic sources like groundnut cake added during fortification.

Application of sand and TCDF in the ratio 3:1 is comparable with application sand and vermicompost in the ratio of 3:1 due to the presence of humic substances and biostimulants similar results were obtained while using vermiwash in vegetables by Gopal *et al.,* (2010).

The TCDF when added showed a slight increase in the number of leaves produced compared to combinations of vermicompost since they have a combination of humic-like substances, inorganic and organic nutrient fractions (Senarathne, 2018).

Moreover, the addition of coir pith during the fortification to decrease the moisture and to bring the texture of the thermochemical digestate to free-flowing nature from lumpy nature gives the added benefit of moisture retention for a longer period of time, improves the bulk density and water holding capacity of the substrate, and prevents the leaching out of nutrients that aids in better nutrient uptake by the seedlings (Azarmi *et al.,* 2008).

The TCDF when used as potting substrate higher root growth was observed in seedlings. The higher root growth is mostly due to the root-promoting character of humic acid (Jindo *et al.,* 2012). The optimum porosity that maintains aeration, as well as the moisture, is another contributing factor to increase the root growth.

The increased root growth increases the nutrient uptake by the plants that in turn stimulates leaf production. The increase in the number of leaves increases the photosynthetic area and biomass production this is in agreement with the results given by Amin *et al.,* (2016). This has led to increased seedling weight in treatment that received TCDF. The plant height was also greater in treatment that received TCDF due to the increased nutrient uptake because of sustained availability of nitrogen and calcium nutrients that increase the plant height and number of leaves (Nathanael, 1961). The enhanced number of leaves, collar girth, the weight of seedlings, and number of thick roots on the application of TCDF resulted in a high z score that indicates the seedling vigor.

Thermochemical digestate fertilizer (TCDF) can be effectively utilized as a potting mixture for raising coconut seedlings in nurseries. The use of sand and TCDF in the ratio 3:1 produced higher collar girth, plant height, and number of leaves. Using potting mixture containing soil, sand, and TCDF in the ratio1:1:1 is also equally good in increasing the seedling vigour. The application of TCDF to the potting medium will enhance the nutrient availability to the seedlings in the initial stages of growth since TCDF is fortified with inorganic nutrient that is readily available to seedlings. The sustained nutrient availability was maintained by the organic fraction of TCDF. The presence of humic substances increases the root development and seedling vigour of coconut seedlings. The application of TCDF based potting mixture in the ratio 2:1 (Sand: TCDF) and soil, sand, and TCDF in the ratio 1:1:1 proves equally good for the production of coconut seedlings.

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References

Amin, O. A., Gawad-Nehad, M. A., Hala-Emam, E. and Abd El-Moneim-Eman, A. A., 2016. Effect of soil application with humic and amino acid on vegetative growth, nutritional statues, yield and fruit quality of Grande Naine banana plants. *International Journal of PharmTech Research*, *9*(12), pp.88-96.

Azarmi, R., Giglou, M. T. and Taleshmikail, R. D., 2008. Influence of vermicompost on soil chemical and physical properties in tomato (*Lycopersicum esculentum*) field. *African Journal of Biotechnology*, *7*(14).pp. 2397-2401.

Jindo, K., Martim, S. A., Navarro, E. C., Pérez-Alfocea, F., Hernandez, T., Garcia, C., Aguiar, N. O. and Canellas, L. P., 2012. Root growth promotion by humic acids from composted and non-composted urban organic wastes. *Plant and Soil*, *353*(1), pp.209-220.

Gopal, M., Gupta, A., Palaniswami, C., Dhanapal, R. and Thomas, G. V., 2010. Coconut leaf vermiwash: a bio-liquid from coconut leaf vermicompost for improving the crop production capacities of soil. *Current science*, pp.1202-1210.

Harries, H. C., 2012. Germination rate is the significant characteristic determining coconut palm diversity. *AoB Plants*, *2012*.

KAU (Kerala Agricultural University) 2016. Package of Practices Recommendations: Crops (15th Ed.). Kerala Agricultural University, Thrissur, 69 p.

Krishnakumar, V. K. and Reddy, D. V. S., 2006. Production of polybag seedlings in coconut. *Indian Coconut Journal*, *36*(12), pp.17-19.

Kumar, V. K., Mathew, J. and Sukumaran, C. K., 1991. Discriminant function analysis in coconut seedlings. *Journal of Plantation Crops*, 18 (Suppl), pp.373-375.

Leno, N. and Sudharmaidevi, C. R., 2018. Micronutrient Dynamics on Addition of a Rapid Organic Fertilizer Produced from Degradable Waste in Banana. *Int. J. Curr. Microbiol. App. Sci*, *7*(1), pp.1095-1102.

Mantiquilla, J. A., Canja, L. H., Margate, R. Z. and Magat, S. S., 1994. The use of organic fertilizer in coconut (A research note). *Philippine Journal of Coconut Studies*, *19*(1), pp.8-13.

Nathanael, W. R. N., 1961. Coconut nutrition and fertilizer requirements-The plant approach.pp.113-120.

Parwaiz, A, B. Inayatullah, R, and Ubedullah, A, T. 2014. Effect of Integrated Nutrient Management on Nut Production of Coconut (*Cocos nucifera* L.) And Soil Environment. A Review. *Sci. Tech. and Dev*., 33 (1) pp.14-21.

Perera, L., Peries, R. R. A. and Jayatileke, R., 1996. Improvement of seedling quality in polybags through manipulation of potting media. In *Cocos*(11) pp. 69-78.

Reddy, D. S., Kumar, S. N. and Prabhu, S. R., 2007. Evaluation of alternative media to potting mixture for raising coconut seedlings in polybags. *Journal of plantation crops*., 29 (1) pp. 62-65.

Senarathne, S. H. S., 2018. Effect of Vermicompost on Growth of Coconut Seedlings under Field Conditions in Sri Lanka. *CORD*, *34*(1), pp.6-6.

Sheoran, O. P., Tonk, D. S., Kaushik, L. S., Hasija, R. C. and Pannu, R. S., 1998. Statistical software package for agricultural research workers. Recent advances in information theory, statistics & computer applications by DS Hooda & RC Hasija Department of Mathematics Statistics, CCS HAU, Hisar, pp.139-143.

Sudharmaidevi, C. R., Thampatti, K. C. M. and Saifudeen, N. 2017. Rapid production of organic fertilizer from degradable waste by thermochemical processing. *International Journal of Recycling of Organic Waste in Agric.*, *6*(1), pp.1-11.

Thomas, K. M., 1974. Influence of Certain Physical and Chemical Treatments on the Germination and Subsequent Growth of Coconut *Cocos nucifera* L. Seedlings: A Preliminary Study. *East African Agricultural and Forestry Journal*, *40*(2), pp.152-156.

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