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Quality assessment of vermicompost and vermiwash prepared from litters of horticultural crops

SY Waghmode, AR Sasane, AP Gawade and RB Ghogare

Abstract
An investigation pertaining to "Quality Assessment of Vermicompost and Vermiwash Prepared From litters of Horticultural Crops" was undertaken during the year 2020 – 2021 at Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra. The experiment was laid out in a Factorial Randomized Block Design (FRBD) With eight treatments and four replications using the leaf litters of Jackfruit (*Artocarpus heterophyllus*), Coconut (*Cocus nucifera*), Areacanut (*Areca catechu*) and Sapota (*Manilkara zapota*) in combination with epigeic species of earthworms namely *Eudrilus euginae* and *Eisenia foetida.* The decomposer was used for rapid composting of leaves wastes and cattle dung was used as substrate. The results indicated that, the pH of vermicompost and vermiwash considerably decreased with increase in electrical conductivity throughout the composting period. In case of macronutrients in vermicompost, the Jackfruit leaf litter was found significantly superior with highest total nitrogen content (1.42%), highest total phosphorus content (0.51%) and highest total potassium content (1.06%). The lowest values of total N, P, K content (1.22%, 0.39%, 0.86%) respectively were observed in case of coconut leaf litter. In case of nutrient content in vermiwash, the maximum NPK content as 114.57 ppm, 30.84 ppm and 197.24 ppm respectively were noticed in case of jackfruit leaf waste at the end of composting period.

Keywords: vermicompost, vermiwash, leaf litters, jackfruit, coconut, Areacanut, sapota, macronutrients, *Eudrilus euginae, Eisenia foetida*

1. Introduction

Solid wastes are generated from all the discarded solid material generally arises from various municipal, industrial and agricultural activities. The main objective of these solid waste management is to collect, control, process and dispose the wastes in an economical way so that public health protection can be achieved. Under agricultural activities, litter fall from all plants largely contributes in solid waste generation and is mainly depends on different climatic features *viz.* temperature, rainfall, humidity and seasonal variations. Generation of leaf litters from the trees planting in public places as well as private places is a major problem in terms of their management/disposal (Alok and Tripathi, 2012) [2]. It is concluded that in India nearly about 700 million tons of organic wastes is generated annually including leaves, husk, sawdust, stem bark, flowers etc. which are either burned or land filled. (Bhiday, 1994) [4]. The conventional method of amputation *viz.* burning, dumping does not only make the environment polluted but it also contributes in affecting the health of human beings (Sannigrahi, 2009) [17]. Dumping the leaves near water bodies like ponds and lakes will also pollute the water and causes problems for the aquatic organisms. The litter accumulating in urban and sub urban areas such as sidewalks, lawns and playgrounds is not only an unseemly sight but also adds to the overall problem of municipal solid waste (MSW) disposal. Also, when these leaf wastes left as such on soil surface in excess quantity, it causes problems such as bad smell and generation of mosquitoes etc. Thus, to tackle with these problems vermicomposting is the better option. Vermicomposting is a simple biotechnological process which involves the stabilization of organic solid wastes through earthworm consumption that converts the waste material into worm castings called as vermicompost. (Bhoyar and Bhide, 1996) [5]. Vermicompost, an organic fertilizer rich in nitrogen 1.5%, phosphorus 0.98%, potassium 1.1%, micronutrients and beneficial soil microbes (nitrogen fixing and phosphate solubilizing bacteria and actinomycetes), is a sustainable alternative option to chemical fertilizers, which can acts as an excellent growth promoter and protector for crop plants. (Sinha *et al*. 2011; Chauhan and singh. 2015) [18, 8]. Therefore the present investigation was aimed to explore the possibility of bioconversion of leaf litters of horticultural crops namely Jackfruit

(*Artocarpus heterophyllus*), Coconut (*Cocus nucifera*), Arecanut (*Areca catechu*) and Sapota (*Manilkara zapota*), leaves into vermicompostfor their chemical analysis by using Epigeic species of earthworms such as *Eudrilus euginae* and *Eisenia foetida*.

2. Material and Methods
2.1 Experimental site
The experiment was conducted at Department of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during September 2020 to February 2021.

2.2 Substrate used
The dry leaf litter of different horticultural crops such as Jackfruit (*Artocarpus heterophyllus*), Coconut (*Cocus nucifera*), Arecanut (*Areca catechu)* and Sapota (*Manilkara zapota*) were used in experiment as substrates.

2.3 Collection and pre-treatment of substrates
The substrate samples *i.e,* fallen dry leaves of Jackfruit, Coconut, Areca-nut and Sapota were collected from the orchad of respective plants present in college campus, which comes under Department of Horticulture, Dapoli. After that, samples were kept for proper drying, then chopped in small fractions of about 2-3 inch sizes. The chopped leaf samples were spreaded on ground, sprinkled with decomposing culture and kept in shady areas for about 15 days by covering them with polythene sheets for pre-decomposition. Apart from this, the fresh cow dung was used for the preparation of slurry by using water in 1: 1 proportion and was sprinkled it over substrate material.

2.4 Earthworm Species
The experimental study was carried out by using epigeic species of earthworms namely *Eudrilus eugeniae* and *Eisenia foetida*. The both earthworm species were brought from M/s. Institute on National Organic Agriculture, Pune.

2.5 Filling of pots and layering of substrates
Thirty- two small earthen pots (60 cm diameter and 60 cm height) were used for vermicomposting of leaf litters. Bottom of the pots was covered with a layer of small pieces of bricks (2-3 inches). A layer of 5 cm thick mixture of sieved garden soil and powdered cow dung in proportion 1:1 was prepared over bricks which served as bedding material. Above that, 25 earthworms were introduced as per treatment and combination along with the partially decomposed leaf substrates (3 kg in each pot). The added organic residues were watered regularly throughout the experimental study *i.e.,* up to 90 days to maintain an optimum moisture level of 50%.

Table 1. Total treatment combinations

Tr. No.	Treatment Combination
T_1	Jackfruit leaf litter + *Eudrilus eugeniae*
T_2	Jackfruit leaf litter + *Eisenia foetida*
T_3	Coconut leaf litter + *Eudrilus eugeniae*
T_4	Coconut leaf litter + *Eisenia foetida*
T_5	Arecanut leaf litter + *Eudrilus eugeniae*
T_6	Arecanut leaf litter + *Eisenia foetida*
T_7	Sapota leaf litter + *Eudrilus eugeniae*
T_8	Sapota leaf litter + *Eisenia foetida*

2.6 Inoculation of Earthworms
Half-decomposed leaf litters were incubated with two different earthworm species namely *Eudrilus eugeniae* and *Eisenia foetida* as per treatments. Each pot was filled with 25 earthworms. The optimum conditions for earthworms activities *i.e.,* moisture level of up to 50% and relative humidity was maintained. The material in the pot was turned over manually at an interval of one month.

2.7 Incubation Study
To understand the nutrient release pattern and changes in chemical properties of final experimental products *viz.,* vermicompost and vermiwash, the incubation study was carried out for about 90 days in FRBD under the influence of two epigeic earthworm species and four types of leaves wastes of horticultural crops.

2.8 Vermicompost and vermiwash sampling
The vermicompost samples from three randomly and well distributed spots in each treatment combinations were collected with the help of augur without disturbing the live worms. The vermiwash samples were collected with the help of plasic bottles and treatment wise vermiwash samples were prepared. The sampling was done thrice during experiment *i.e.,* at 30 DAI, 60 DAI and 90 DAI of vermicomposting and treatment wise composite vermicompost sample was prepared by mixing. The chemical properties *viz.* pH, EC, total N, P, K were analysed from air dried vermicompost samples and vermiwash samples.

2.9 Nutrient analysis
pH and Electrical conductivity were determined by the method using 1:10 compost: water suspension ratio (Jackson, 1973) [11]. Total nitrogen were determined by Kjeldahl modified sulfuric salicylic acid mixture. (Jackson, 1973) [11]. Total phosphorus was determined calorimetrically by using spectrophotometer at 420 nm wavelength. (Jackson, 1973) [11]. Total potassium of vermicompost samples was estimated by using flame-photometry in which digested diluted di-acid solution used for feeding purpose. (Piper, 2010) [15]. In case of nutrient analysis of vermiwash, pH and Electrical conductivity were determined using 1:10 v/v suspension ratio (Garg *et al*. 2006) [10]. Total N was determined in by the kjeldahl method by using concentrated sulphuric acid, K_2SO_4 and selenium to digest sample and was estimated according to Bremmer and Mulvaney (1982) [6]. Total Phosphorus was determined calorimetrically by using spectrophotometer at 420 nm wavelength. (Jackson, 1973) [11]. Total potassium content was determined after digesting samples in diacid mixture by using Flame photometer method given by Bansal and kapoor, 2000 [3].

3. Results and Discussion
3.1 pH of vermicompost
The data given in Table 2 indicated that the changes in pH during composting of organic residues was found to be significant only on 30 DAI of composting. The treatment S_1 *i.e.,* jackfruit leaf litter recorded highest pH values 7.88, 7.80 on 30 and 60 DAI of composting respectively; while treatment S_2 *i.e.,* coconut leaf litter recorded the highest pH values (7.39) at 90 days. At 30 DAI, the maximum pH (7.96) was observed in the treatment S_1 *i.e.,* jackfruit leaf litter which was significantly higher over rest of the treatment. Albanell *et al.* (1988) [1] reported that, the production of CO_2 and organic

acids by the microbial metabolism during decomposition of different substrates might be responsible for the lower pH in vermicompost samples.

3.2 Electrical conductivity (dSm^{-1}) of vermicompost
The data regarding electrical conductivity presented in Table 3 revealed that the the electrical conductivity continuosly increases during the composting period ranging from 30, 60 and 90 DAI of composting and shows non significant results. Increase in EC during vermicomposting might be due do the decomposition of substrates and subsequent liberated exchangeable bases and also due to the variation in biochemical constituents of various crop residues. (Mayadevi and Sushama, 2016) [14].

3.3 Total nitrogen content of vermicompost
The data expressed in Table 4 indicated that the maximum total nitrogen content (1.02%, 1.27% and 1.42%) on 30, 60 and 90 DAI of composting respectivey was found in treatment S_1 *i.e,* Jackfruit leaf litter while the minimum total nitogen content was observed in coconut leaf litter (0.87%, 0.94% and 1.22% on 30, 60 and 90 DAI of composting respectively). Bansal *et al.* (2000) [3] reported that the increase in total nitrogen content of vermicompost was probably due to mineralization of organic matter having protein. According to Tripathi and Bhardwaj (2004) [19], the losses of organic carbon might be responsible for N addition in the form of mucus nitrogeneous excretory substances, growth stimulatory enxymes, hormones from the gut of earthworms.

3.4 Total phosphorus content of vermicompost
The data regarding the total phosphorus content of different leaf litters given in table 5 indicated thaton 30, 60 and 90 DAI of composting the maximum total phosphorus content was obtained in treatment S_1 (jackfruit leaf litter) *i.e,* 0.47%, 0.49% and 0.51% respectively; while the minimum total phosphorus content were observed in treatment S_2 (coconut leaf litter) *i.e*, 0.33%, 0.37% and 0.39% respectively. The treatment S_1 containing jackfruit leaf litter was found significantly superior over the rest of the treatments during all the days of composting. The enhancement in phosphorus during vermicomposting might be due to mineralization and mobilization of organic matter due to bacterial and fecal phosphatase activity of earthworms. Increase in total phosphorus content was attributed due to the direct action of worm gut enzyme and indirectly by the stimulation of microflora. (Edwards and Lofty, 1972) [9].

3.5 Total potassium content of vermicompost
The data presented in Table 6 revealed that the higher total potassium content was found in treatment S_1 containing jackfruit leaf litter ranging from 0.90%, 0.98% and 1.06%; respectively on 30, 60 and 90 DAI of composting; whereas the lower total potassium content were observed in treatment S_2 containing coconut leaf litter *i.e,* 0.72%, 0.80% and 0.86% on 30, 60 and 90 DAI of composting; respectively. Rao *et al.* (1996) [16] reported that the selective feeding of earthworms on organically rich material breakdown the substances during the passage through their gut, biological grinding, together with enzymatic influence on finer soil particles, were slightly responsible for increasing the different forms of k.

3.6 pH of vermiwash
The data regarding pH given in Table 7 showed that the pH of vermiwash samples get decreased with increased in composting period. The microbial decomposition of residues are mainly responsible for shifting of pH during the entire period of composting. According to Garg *et al.* (2006) [10] the mineralization of nitrogen into nitrate/ nitrite and phosphate into orthophosphate responsible for transferring of pH from basic to acidic or neutral condition.

3.7 Electrical conductivity of vermiwash
The data regarding electrical conductivity presented in Table 8 revealed that the differences in the values of EC of vermiwash prepared from the substrates such as jackfruit leaf litter, coconut leaf litter, arecanut leaf litter and sapota leaf litter with inoculation of two earthworm *sp. viz, Eudrilus euginae* and *Eisenia foetida* exhibited non-significant results on 30, 60 and 90 DAI of observations. Bhiday (1994) [4] found significant increase in EC which indicates the presence of soluble salts in final compost product and was mainly due to the conversion of unavailable forms of nutrients into available forms. The destruction of organic matter and subsequently release of mineral salts resulted in decreased in EC. (Chauhan and Singh, 2012) [7].

3.8 Total nitrogen content of vermiwash
The data presented in Table 9 revealed that the vermiwash obtained from treatment S_1 *i.e*, composting of jackfruit leaf litter recorded higher total nitrogen content (77.56 ppm, 112.29 ppm and 114.57 ppm) on 30, 60 and 90 DAI of vermicomposting respectively. Tripathi and Bhardwaj (2004) [19] reported that nitrogen is mainly present in vermiwash in the form of mucus, nitrogeneous excretory substances, growth stimulating hormones and enzymes. The degradation of organic carbon with addition of some gut products of earthworms in the form of castings, urine and dead tissues may be resposonsible for increase in total kjeldahl nitrogen in vermiwash.

3.9 Total phosphorus content of vermiwash
The data pertaining to the changes in total phosphorus content of vermiwash obtained from the composting of leaf litter presented in Table 10 which showed that, at 30 DAI, it was observed that the maximum total phosphorus content was found in treatment S_1 *i.e,* jackfruit leaf litter (25.25 ppm) followed by sapota leaf litter (21.85 ppm), arecanut leaf litter (24.04 ppm), coconut leaf litter (19.63 ppm).Also, at 60 and 90 DAI of composting period, values of total phosphorus content were ranged from 28.80 ppm to 27.45 ppm and 30.84 ppm to 28.65 ppm respectively. Lee (1991) concluded that increased in phosphorus content during vermicomposting is mainly due to the derived phosphatase activities by gut of earthworms and increased in microbial activities.

3.10 Total potassium content of vermiwash
The data depicted in Table 11 indicated that the differences in total potassium content in vermiwash of different leaf litters were found statistically significant throughout the period of composting. At 30,60 and 90 DAI, it was observed that the maximum total potassium content (148.98 ppm, 170.83 ppm and 197.24 ppm respectively) was found in treatment S_1 *i.e*, jackfruit leaf litter while minimum total potassium content (136.80 ppm, 153.80 ppm and 177.28 ppm) was found in treatment S_2 *i.e*, coconut leaf litter. The presence of maximum no. of symbiotic micro flora in the gut and cast of earthworms along with secreted mucus and water causes the ingested OM degradation which resulted in increased in K content in vermiwash. (Kaviraj and Sharma, 2003) [12].

Table 2: Changes in pH of vermicompost during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean
S_1	Jackfruit leaf litter	7.96	7.81	7.88	7.70	7.90	7.80	6.98	7.12	7.05
S_2	Coconut leaf litter	7.71	7.96	7.84	7.93	7.59	7.76	7.45	7.33	7.39
S_3	Arecanut leaf litter	7.84	7.70	7.77	7.74	7.59	7.67	6.95	6.89	6.92
S_4	Sapota leaf litter	7.71	8.03	7.87	7.56	7.95	7.76	7.11	7.28	7.19
Mean		7.80	7.87	7.83	7.73	7.76	7.74	7.74	7.15	7.13
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.01	0.01	0.02	0.06	0.04	0.09	0.07	0.05	0.10
C.D. at 5%		0.04	0.03	0.06	NS	NS	0.27	0.21	NS	NS

Table 3: Changes in electrical conductivity (dSm^{-1}) of vermicompost during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean
S_1	Jackfruit leaf litter	0.98	0.96	0.97	1.31	1.24	1.27	1.65	1.67	1.66
S_2	Coconut leaf litter	1.01	0.93	0.97	1.35	1.29	1.32	1.67	1.54	1.60
S_3	Arecanut leaf litter	1.16	1.14	1.15	1.39	1.31	1.35	1.78	1.71	1.74
S_4	Sapota leaf litter	1.09	1.04	1.06	1.36	1.30	1.33	1.70	1.68	1.69
Mean		1.06	1.01	1.03	1.35	1.28	1.30	1.70	1.65	1.67
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.02	0.01	0.03	0.03	0.02	0.04	0.03	0.02	0.05
C.D. at 5%		NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 4: Changes in total nitrogen content (%) of vermicompost during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean
S_1	Jackfruit leaf litter	1.13	0.92	1.02	1.32	1.23	1.27	1.46	1.39	1.42
S_2	Coconut leaf litter	0.88	0.86	0.87	0.97	0.94	0.95	1.24	1.19	1.22
S_3	Arecanut leaf litter	0.93	0.89	0.91	1.08	1.01	1.05	1.28	1.21	1.25
S_4	Sapota leaf litter	1.03	0.86	0.94	1.27	1.12	1.19	1.41	1.35	1.38
Mean		0.99	0.88	0.93	1.16	1.07	1.11	1.35	1.28	1.31
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.010	0.007	0.014	0.016	0.011	0.023	0.007	0.005	0.010
C.D. at 5%		0.030	0.021	0.042	0.048	0.034	NS	0.022	0.015	NS

Table 5: Changes in total phosphorus content (%) of vermicompost during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean
S_1	Jackfruit leaf litter	0.49	0.46	0.47	0.52	0.46	0.49	0.53	0.49	0.51
S_2	Coconut leaf litter	0.36	0.30	0.33	0.40	0.35	0.37	0.41	0.37	0.39
S_3	Arecanut leaf litter	0.40	0.33	0.37	0.42	0.37	0.39	0.44	0.41	0.42
S_4	Sapota leaf litter	0.46	0.42	0.44	0.50	0.44	0.47	0.51	0.47	0.49
Mean		0.43	0.38	0.40	0.46	0.40	0.43	0.47	0.43	0.45
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.004	0.003	0.006	0.004	0.003	0.006	0.004	0.003	0.006
C.D. at 5%		0.014	0.009	0.018	0.013	0.009	NS	0.013	0.009	NS

S – Substrate effect, E – Earthworm effect, NS – Non – Significant, E_1 - *Eudrilus euginae,* E_2 – *Eisenia foetida.*

Table 6: Changes in total potassium content (%) of vermicompost during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean
S_1	Jackfruit leaf litter	0.93	0.88	0.90	1.01	0.95	0.98	1.11	1.02	1.06
S_2	Coconut leaf litter	0.74	0.71	0.72	0.82	0.78	0.80	0.90	0.83	0.86
S_3	Arecanut leaf litter	0.85	0.81	0.83	0.96	0.87	0.91	1.06	0.96	1.01
S_4	Sapota leaf litter	0.86	0.82	0.84	0.98	0.91	0.94	1.09	0.98	1.03
Mean		0.84	0.80	0.82	0.94	0.87	0.90	1.04	0.94	1.32
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.008	0.006	0.012	0.007	0.005	0.010	0.006	0.004	0.009
C.D. at 5%		0.025	0.018	NS	0.022	0.015	NS	0.018	0.013	NS

Table 7: Changes in pH of vermiwash during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**
S_1	Jackfruit leaf litter	7.89	7.85	7.87	7.92	7.79	7.85	7.81	7.74	7.77
S_2	Coconut leaf litter	7.89	7.86	7.87	7.81	7.77	7.79	7.75	7.72	7.73
S_3	Arecanut leaf litter	7.80	7.73	7.76	7.72	7.68	7.70	7.64	7.60	7.62
S_4	Sapota leaf litter	8.19	7.92	8.05	7.80	7.79	7.79	7.71	7.69	7.70
Mean		7.94	7.84	7.89	7.81	7.75	7.78	7.72	7.68	7.70
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.06	0.04	0.09	0.08	0.06	0.12	0.20	0.14	0.29
C.D. at 5%		0.19	NS	NS	NS	NS	NS	NS	NS	NS

S – Substrate effect, E – Earthworm effect, NS – Non – Significant, E_1 - *Eudrilus euginae,* E_2 – *Eisenia foetida*

Table 8: Changes in EC (dSm^{-1}) of vermiwash during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**
S_1	Jackfruit leaf litter	0.885	0.935	0.910	0.974	0.943	0.958	1.006	1.005	1.005
S_2	Coconut leaf litter	0.882	0.880	0.881	0.983	0.997	0.990	1.036	1.011	1.024
S_3	Arecanut leaf litter	0.885	0.868	0.876	0.972	0.963	0.967	1.005	0.990	0.998
S_4	Sapota leaf litter	0.878	0.813	0.895	0.998	0.948	0.973	1.094	0.997	1.046
Mean		0.882	0.899	0.890	0.982	0.963	0.972	1.035	1.001	1.018
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.018	0.013	0.026	0.016	0.011	0.022	0.023	0.017	0.033
C.D. at 5%		NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 9: Changes in total nitrogen content (ppm) of vermiwash during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**
S_1	Jackfruit leaf litter	81.60	73.53	77.56	118.70	105.88	112.29	122.95	106.20	114.57
S_2	Coconut leaf litter	65.15	59.42	62.28	94.64	81.37	88.00	88.97	81.53	85.25
S_3	Arecanut leaf litter	67.76	61.83	64.79	92.11	80.09	86.10	93.82	84.36	89.09
S_4	Sapota leaf litter	78.44	71.13	74.78	115.28	104.38	109.83	119.71	102.68	111.19
Mean		73.23	66.48	69.85	105.19	92.93	99.05	106.36	93.69	100.02
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.20	0.14	0.28	0.15	0.10	0.21	0.16	0.11	0.23
C.D. at 5%		0.60	0.42	0.85	0.45	0.32	0.64	0.49	0.35	0.70

S – Substrate effect, E – Earthworm effect, NS – Non – Significant, E_1 - *Eudrilus euginae,* E_2 – *Eisenia foetida.*

Table 10: Changes in total phosphorus content (ppm) of vermiwash during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**
S_1	Jackfruit leaf litter	26.39	24.12	25.25	29.86	27.73	28.80	31.69	29.99	30.84
S_2	Coconut leaf litter	21.06	18.20	19.63	24.68	22.35	23.52	25.57	22.92	24.24
S_3	Arecanut leaf litter	22.78	20.92	24.04	25.83	25.05	25.42	27.34	25.65	26.49
S_4	Sapota leaf litter	24.90	23.18	21.85	28.05	26.86	27.45	28.76	28.53	28.65
Mean		23.78	21.60	22.69	27.10	25.49	26.29	28.34	26.77	27.55
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.14	0.10	0.20	0.15	0.10	0.21	0.15	0.11	0.22
C.D. at 5%		0.43	0.30	NS	0.45	0.31	0.63	0.46	0.33	0.66

Table 11: Changes in total potassium content (ppm) of vermiwash during composting of organic residues

Treatment effect		30 DAI			60 DAI			90 DAI		
		E_1	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**
S_1	Jackfruit leaf litter	152.25	145.71	148.98	173.94	167.72	170.83	201.94	192.55	197.24
S_2	Coconut leaf litter	137.78	135.81	136.80	157.45	150.16	153.80	180.15	174.41	177.28
S_3	Arecanut leaf litter	140.61	137.77	139.19	159.49	152.87	156.18	183.60	177.06	180.33
S_4	Sapota leaf litter	149.42	143.66	146.54	170.96	165.50	168.23	198.28	190.32	194.30
Mean		145.01	140.74	142.87	165.46	159.06	162.26	190.99	183.58	187.28
		S	E	S×E	S	E	S×E	S	E	S×E
S.E. ±		0.13	0.09	0.19	0.16	0.11	0.23	0.19	0.13	0.27
C.D. at 5%		0.40	0.28	0.57	0.49	0.35	0.70	0.57	0.40	0.81

S – Substrate effect, E – Earthworm effect, NS – Non – Significant, E_1 - *Eudrilus euginae,* E_2 – *Eisenia foetida.*

4. Conclusion

Leaves falling off from trees are common in winter season, but the dumping or burning incidents of leaf litter causes lots of air pollution as well as other adverse environmental problem. The recycling of leaf wastes through vermitechnology reduces the problem of non-utilization of agro-wastes. On the basis of data obtained from present investigation, it can be concluded that, amongst the different sources (leaf litter) used for the preparation of vermicompost and vermiwash, jackfruit leaf litter was found to be the best source for rapid composting and in terms of preferable quality of vermicompost and vermiwash production with maximum nutrient content followed by sapota leaf litter.

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