Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S

Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(6): 2266-2271

Received: 24-09-2017
Accepted: 28-10-2017

SS Patil
Department of Soil Science and Agricultural Chemistry, Dr. B.S.K.K.V., Dapoli, Maharashtra, India

RV Dhopavkar
Department of Soil Science and Agricultural Chemistry, Dr. B.S.K.K.V., Dapoli, Maharashtra, India

MC Kasture
Department of Soil Science and Agricultural Chemistry, Dr. B.S.K.K.V., Dapoli, Maharashtra, India

YR Parulekar
Department of Soil Science and Agricultural Chemistry, Dr. B.S.K.K.V., Dapoli, Maharashtra, India

Correspondence
MC Kasture
Department of Soil Science and Agricultural Chemistry, Dr. B.S.K.K.V., Dapoli, Maharashtra, India

Vermicomposting of coconut coir waste by utilizing epigeic earthworm species

SS Patil, RV Dhopavkar, MC Kasture and YR Parulekar

Abstract
The present investigation was initiated to study the vermicomposting of coconut coir waste by utilizing two epigeic earthworm species *viz. Eudrilus euginae* (E_1) and *Eisenia foetida* (E_2) at Centre of Excellence for Mango, Department of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during the Rabi season of 2015-16 for 180 days. Coconut coir *i.e.* coir waste *(Cocos nucifera* L.*)* was used as a main substrate and cow dung waste was used as a waste material in different combinations for preparation of vermicompost such as M_1-Coir waste (100%), M_2-Coir waste :cow dung- (80:20%), M_3- Coir waste :cow dung (60:40%), M_4- Coir waste :cow dung (40:60), M_5- Coir waste :cow dung (20:80%), M_6- Cow dung (100%). Based on the findings of the present investigation, it could concluded that amongst the various combinations of organic residues evaluated, cow dung was found to be the best source for rapid composting followed by 20:80 combination of coir waste and cow dung. As far as the manurial value is concerned, 20:80 combination of coir waste and cow dung found to be the best combination from the point of macro nutrient contents. Between the two species of earthworms, *Eudrilus euginae* species of earthworm found superior over *Eisenia foetida* species of earthworm in respect of most of the parameters studied. The manurial value of all the compost products improved due to vermicomposting.

Keywords: Coconut, cow dung, coir, earthworms

1. Introduction

Coconut (*Cocos nucifera* L.*)* is cultivated in more than 93 countries of the world in 12.05 million hectares. Among these India occupies third place with 1.89 million hectares producing 12.821 million nuts/annum [19]. The coir, one of the byproduct of coconut is used for the production of ropes, mats, bags, etc [4]. In India, the annual production of coir waste is about 1.39 million tones and of all the states the Karnataka alone produces about 140-150 thousand tones. The generated waste is of great concern to the environment of our area as they are burnt. Further in order to alleviate the deleterious effects of inorganic fertilizers in the soil and environment, now-a-days scientists advocate development of novel technologies to produce organic manures from agro–industrial wastes [15]. In recent years, earthworm has been identified as one of the important organisms to process the biodegradable organic matter. An important feature of vermicompost is that during the processes of various organic wastes by earthworms, many of the nutrients that the wastes contain are changed into plant usable forms [6]. Application of vermicompost to crop fields can improve the physico-chemical and biological properties of the soil [12].

The waste of coir yarn industry (coir pith) gets accumulated in large quantities making their disposal difficult, though it used as soil conditioner[5]. Very often coir pith is heaped as mounds on way side. Coir pith is easily blown by wind due to its light weight thereby creating air pollution. During burning of coir pith high levels of carbon dioxide and smoke are released due to its poor combustion properties [14, 21].

Vermicompost is the excreta of earthworm, which are capable of improving soil health and nutrient status. Vermiculture is a process by which all types of biodegradable wastes such as farm wastes, kitchen wastes, market wastes, bio-wastes of agro based industries, live-stock wastes etc. are converted while passing through the worm-gut to nutrient rich vermicompost [22]. Vermin worms are used here act as biological agents to consume those wastes and to deposit excreta in the process called vermicompost. At present we are using chemical fertilizers in great quantities to compensate the deficiency of nutrients in soil. For minimizing the accumulation of pollutants in agro ecosystems, we should avoid the use of toxic chemicals especially synthetic chemical pesticides and fertilizers in agricultural process. Organic products are eco-friendly natural sources, which can be considered as an alternative to sustainable agriculture development. In India, as a step towards the expansion of native sources, the application of organic waste materials will be useful for achieving higher production [23].

Limitations in the availability of conventional manures like farmyard manure (FYM), poultry litter, cow dung etc., can be overcome through the exploitation of new sources of organic matter like coir pith. Coir pith is comparatively rich in potash, but low in Nitrogen & Phosphorous besides higher proportion of lignin, cellulose and hemicelluloses [1]. It also contains appreciable amounts of micro nutrients. The low amount of nitrogen which results in high C/N ratio makes the material refractory [11]. So, coir pith is considered to be a safe, effective & environmentally friendly process. Coir waste contains pH-6.8, EC-0.76 dSm^{-1}, N-0.47 per cent, P-0.06 per cent, K-1.02 per cent Cu-39.25ppm and Fe-1356.30 ppm [13].

E. eugeniae is a large worm that grows extremely rapidly and is reasonably prolific and under optimum conditions it would be ideal for animal feed protein production. The epigeic earthworm species *Eisenia foetida* is a suitable earthworm species for vermicomposting which have short life cycle, small size and high rate of conversion of organic wastes as well as reproduction [16].

It is therefore imperative to convert the different waste to generate in huge amount to produce good quality vermicompost with minimum period of time. Take this into consideration the present study "Vermicomposting of coconut coir waste by utilizing epigeic earthworm species" is being undertaken with following objectives: Number of days required for maturation of vermicompost, Changes in chemical properties during vermicomposting and Changes in primary nutrients during vermicomposting.

2. Materials and Methods

This study was conducted at Centre of Excellence for Mango, Department of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during the Rabi season of 2015-16 for 180 days. Coconut coir i.e. coir waste *(Cocos nucifera* L.*)* was used as a main substrate and cow dung waste was used as a waste material in different combinations for preparation of vermicompost as M_1-Coir waste (100%), M_2-Coir waste :cow dung- (80:20%), M_3- Coir waste :cow dung (60:40%), M_4-Coir waste :cow dung (40:60), M_5- Coir waste :cow dung (20:80%), M_6- Cow dung (100%). The earthworm species *Eudrilus euginae* and *Eisenia foetida* utilized for vermicomposting. The species *Eudrilus euginae* were brought from M/s. Institute of Natural Organic Agriculture, Pune and *Eisenia foetida* were brought from Vanashri Agrotech, Pune. Vermicomposting was performed in plastic pots. The pots were first thoroughly cleaned with water and two holes were kept at the bottom side of the pots for drainage purpose and then rinsed with distilled water before using for vermicomposting.

2.1 Layering of organic residues

Bottom of the pot was covered with a layer of bricks as a bedding material. Immediately above a layer of well mixed partially decomposed waste material as per the respective combination of the treatment was spread and was sufficiently moistened to maintain the moisture around 50 per cent. Then the pots were covered with gunny bags to maintain adequate moisture and body temperature of earthworms and to protect against termites, ants and rats. The organic residues were watered regularly so as to maintain an optimum moisture level of 50 per cent for a period of 180 days.

2.2 Inoculation of earthworms

After sufficient watering of the vermibeds layer (waste material combination) to 50 per cent moisture content, two hundred earthworms of *Eudrilus euginae* and *Eisenia foetida* species were introduced as per treatment as an optimum inoculating density in the vermibeds of each pots. The material in the tubs was turned over manually at an interval of one month. Optimum moisture level of 50 per cent and average relative humidity was maintained throughout the period of composting.

2.3 Incubation study

To understand the nutrient release pattern, changes in chemical properties of compost under the influence of earthworms and time of composting, an incubation study was conducted for 180 days in Factorial Randomized Block Design comprising of six treatment combinations with two species of earthworms replicated three times.

The vermicompost samples from three randomly and well distributed spots in each treatment combinations were collected with the augur without disturbing the live worms at 30 DAI, 60 DAI, 90 DAI, 120 DAI, 150 DAI, and 180 DAI of vermicomposting and treatment wise vermicompost samples were prepared by mixing. Organic carbon, C: N ratio, total N, P, K were determined from dried samples which were prepared by air drying in shade.

2.4 Organic carbon (%)

Organic carbon of vermicompost samples was determined by preparing ash in the muffle furnace at constant temperature of 550ºC. Organic carbon was calculated by multiplying the per cent loss on ignition by 0.58 [18].

2.5 Total Nitrogen (%)

The organic matter samples were digested in H_2SO_4 and made colorless by adding 30% H_2O_2 and cooled. The digested material was transferred to 25 ml volumetric flask and final volume was made 25 ml with distilled water with repeated washing of digestion flasks and the total nitrogen content was determined by Kjeldhal plus apparatus [8].

2.6 C: N ratio

C: N ratio of vermicompost samples was determined by dividing organic carbon by total nitrogen.

2.7 Total Phosphorus (%)

For determination of total phosphorus of vermincompost samples 1.0 g organic matter sample was digested with di-acid mixture (HNO_3+$HClO_4$) in 9:4 proportions and the yellow colour was developed with combined vanado-molyb date reagent. Phosphorus was determined calorimetrically by using spectrophotometer at 420 nm wave length [8].

2.8 Total Potassium (%)

Total potassium of vermicompost samples was estimated flame photometry by feeding diluted di-acid digested solution [18].

2.9 Statistical Analysis

Statistical analysis of the data was carried out by Factorial Randomized Block Design as given by [17].

3. Results and Discussion

3.1 Number of days required for Vermicomposting

It was observed that the 100 per cent cow dung *i.e*. M_6 decomposed rapidly within 63.83 days followed by the M_5 treatment in which 20:80 proportion of coir waste and cow dung was used. But the treatment M_6 found significantly superior within all the treatments of the material combinations. Regarding the different earthworm species used, it was observed that the *Eudrilus euginae* found highly voracious feeder which decomposed the material within 110 days which was also significantly superior over *Eisenia foetida*. However, the interaction effect of both *i.e.* combination of coir waste and earthworm species did not rich the level of significance regarding the maturation period required for the composting.

3.2 Changes in chemical properties during vermicomposting

The chemical changes in vermicompost prepared with coir waste as a main substrate combined with cow dung were periodically studied at an interval of thirty days during vermicomposting it was observed that the organic carbon and C:N ratio were decreasing with advancement of number of days from 30 to 180 DAI.

3.2.1 Organic Carbon

It was observed that the organic carbon content was recorded minimum (20.45%) after 180 DAI in M_6 *i.e.* Cow dung (100%) and M_1 *i.e.* Coir waste (100%) has recorded maximum (28.48%). Among the two earthworms species used E_1 *i.e. Eudrillus euginae* has minimum carbon content (22.95 %) after 180 DAI than E_2 *i.e. Eisenia foetida* (23.64%).
However, the interaction effects *i.e.* combination of coir waste and earthworm species, it was observed that the organic carbon content was decreased as advancement with DAI from 30 to 180 DAI and found minimum *i.e.* 20.29% as shown in Table 2.
There was a considerable decrease in the per cent organic carbon content with the advancement of period of composting. This may be due to mineralization of carbon by organism for their energy source and also observed that, by the end of 150 days of composting of mango leaves, Ain leaves, Shivan leaves and Cashew leaves, the maximum loss of organic carbon was noticed in case of mango leaves followed by Ain leaves, Cashew leaves and Shivan leaves [2].
The organic carbon were significantly affected by composting and vermicomposting. He was found that the percentage of organic carbon decreased from ambient to mesophilic, cooling down stage and during the period of vermicomposting which shows the decomposition of waste by microbial population [10].

3.2.2 C: N Ratio

The C: N ratio has similar trend as like of organic carbon content. The M_6 treatment has recorded minimum C: N ratio after completion of 180 DAI *i.e.* 16.85 percent and M_1 recorded maximum *i.e.*29.33 percent.
The earthworm species *Eudrillus euginae* (E_1) was found superior than *Eisenia foetida* (E_2) with minimum C: N ratio 19.74 per cent. The interaction effect of both combinations of coir waste and earthworm species, treatment M_5 *i.e.*20:80 proportion of coir waste and Cow dung treated with *Eudrilus euginae* was significant among all the combination of treatments and recorded minimum C: N ratio (16.27%) as shown in Table 3.
Inoculation of earthworms in local grass did not help to reduce the C: N ratio below 20 on 150th day of composting, perhaps due to higher proportion of lignin associated with the local grass [7].

3.3 Changes in primary nutrient (N, P, K) content during vermicomposting

The primary nutrient content increased with advancement of days after inoculation From 30 DAI to 180 DAI for all the content of N, P and K under the study. For these primary nutrients M_1 treatment takes longer period to reach maximum level followed by M_2, M_3, M_4, M_5, and M_6 which required minimum time for maturation of vermicompost.
Among the six treatments M_1 (Coir waste) has minimum content of N (0.97%), P (0.39%), K (0.57%), whereas, treatment M_5 has recorded maximum content of N (1.30%), P (0.52%), K (0.83%) which was followed by treatment M_4 having N content (1.23%), whereas for P content treatment M_6 followed by M_5 having (0.50%) and treatment M_4 having K content (0.73%).
During period of composting *Eudrilus euginae* species of earthworm found superior for the entire primary nutrient such as Nitrogen 1.18 per cent, Phosphorus 0.49 per cent and Potassium 0.69 per cent than those treated with *Eisenia foetida* species of earthworm 1.15 per cent, 0.45 per cent, and 0.66 per cent, respectively. An interaction effect of material and earthworms was found non-significant throughout the period of composting for N, P and K (Table 4, 5, 6).
It was observed that the total nitrogen content of all the composting material was increased gradually and considerable as function of time in all the residues with inoculation of earthworms. The presence of earthworm had a marked effect on nitrogen transformation in composting residues. Nitrogen mineralization was greater in presence of earthworms which may be due to be the favorable condition for nitrification produced by *Eudrilus euginae* and *Eisenia foetida*. The earthworm species *Eisenia foetida* in cow dung slurry increased the nitrate nitrogen content [7]. Loss of organic carbon might be responsible for nitrogen addition in the form mucus nitrogenous excretory substances, growth stimulatory hormones and enzymes from the gut of earthworms [25].
In general the compositing of coir waste along with cow dung in different proportions resulted into increase in phosphorus content of final products. The increase in the total phosphorous content may be due to the contribution of phosphorous by worm cast [20, 3, 9].
The increase in potassium of the vermicompost in relation to that of the simple compost and substrate was probably because of physical decomposition of organic matter of waste due to biological grinding during passage through the gut, coupled with enzymatic activity in worm's gut, which may have caused its increase [24].

Table 1: Days required for vermicomposting of the different waste material

Treatments details		Species of earthworms		Mean
		***Eudrilus euginae* (E_1)**	***Eisenia foetida* (E_2)**	
M_1	Coir waste (100%)	165.00	172.00	168.50
M_2	Coir waste :cow dung (80:20)	147.67	154.00	150.83
M_3	Coir waste :cow dung (60:40)	125.67	131.33	128.50
M_4	Coir waste :cow dung (40:60)	91.00	93.67	92.33
M_5	Coir waste :cow dung (20:80)	71.33	74.00	72.67
M_6	Cow dung (100%)	62.00	65.67	63.83
Mean		110.44	115.11	
		M	E	M X E
S.E. ±		1.44	0.55	2.04
C.D. at 5%		4.22	1.62	NS

M-Material effect, E – Earthworm effect, NS- Non Significant

Table 2: Periodical changes in organic carbon (%) content during composting of organic residues

Treatment details	30 DAI			60 DAI			90 DAI			120 DAI			150 DAI			180 DAI		
	E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean
M_1	39.79	41.62	40.71	38.22	38.85	38.54	36.55	36.74	36.65	34.55	34.65	34.60	32.55	32.93	32.74	27.22	29.75	28.48
M_2	38.19	39.10	38.65	35.35	37.65	36.50	32.69	34.09	33.39	31.69	33.32	32.50	24.50	24.72	24.61	24.53	24.75	24.64
M_3	35.67	36.92	36.30	34.06	35.87	34.96	31.34	33.54	32.44	28.39	30.54	29.46	22.53	23.20	22.87	22.54	23.27	22.91
M_4	34.47	35.21	34.84	31.76	32.31	32.03	22.42	23.31	22.87	21.89	22.04	21.97	21.90	22.09	22.00	21.92	22.15	22.04
M_5	32.13	34.36	33.25	29.02	30.98	30.00	21.11	21.18	21.15	21.15	21.22	21.18	21.18	21.30	21.24	21.20	21.35	21.28
M_6	29.87	31.74	30.80	23.01	24.32	23.67	20.18	20.51	20.35	20.20	20.53	20.37	20.25	20.54	20.40	20.29	20.60	20.45
Mean	35.02	36.49		31.90	33.33		27.38	28.31		26.31	27.05		23.82	24.13		22.95	23.64	
	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E
S.E. ±	0.34	0.17	0.49	0.42	0.21	0.59	0.15	0.24	0.21	0.12	0.26	0.18	0.08	0.06	0.11	0.15	0.27	0.21
C.D. at 5%	1.01	0.51	NS	1.22	0.61	NS	0.43	0.70	0.61	0.36	0.77	0.51	0.22	0.17	NS	0.43	0.78	0.61

EE – *Eudrilus euginae* M_1 - Coir waste (100%) M_3 - Coir waste: cow dung (60:40) M_5 - Coir waste: cow dung (20:80)
EF – *Eisenia foetida* M_2 - Coir waste: cow dung (80:20) M_4 - Coir waste: cow dung (40:60) M_6 - cow dung (100%)

Table 3: Periodical changes in C: N ratio during composting of organic residues

Treatment details	30 DAI			60 DAI			90 DAI			120 DAI			150 DAI			180 DAI		
	E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean	E_1	E_2	Mean
M_1	51.48	57.03	54.25	44.61	47.37	45.99	40.63	41.40	41.01	36.69	37.38	37.04	33.91	34.91	34.41	27.78	30.89	29.33
M_2	47.19	50.14	48.66	38.56	42.63	40.60	34.29	37.33	35.81	31.90	35.33	33.62	21.89	22.47	22.18	22.10	22.92	22.51
M_3	42.82	45.46	44.14	35.39	38.43	36.91	31.76	35.58	33.67	27.74	31.06	29.40	18.02	19.34	18.68	18.18	19.72	18.95
M_4	38.30	40.66	39.48	28.77	31.46	30.12	17.94	19.37	18.65	17.10	18.07	17.58	17.38	18.11	17.74	17.54	18.36	17.95
M_5	32.67	35.79	34.23	25.54	27.75	26.64	16.16	16.42	16.29	16.02	16.45	16.24	15.81	16.64	16.22	16.27	16.59	16.43
M_6	27.51	31.47	29.49	19.50	21.21	20.36	16.27	17.29	16.78	16.29	16.83	16.56	16.60	17.12	16.86	16.59	17.12	16.85
Mean	39.99	43.42		32.06	34.81		26.17	27.90		24.29	25.85		20.60	21.43		19.74	20.93	
	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E
S.E. ±	0.61	0.34	0.87	0.50	0.23	0.70	0.42	0.40	0.60	0.41	0.41	0.58	0.14	0.08	0.20	0.20	0.30	0.28
C.D. at 5%	1.80	0.99	NS	1.46	0.68	NS	1.24	1.18	1.75	1.19	1.20	1.69	0.41	0.25	NS	0.58	0.87	0.82

EE – *Eudrilus euginae* M_1 - Coir waste (100%) M_3 - Coir waste: cow dung (60:40) M_5 - Coir waste: cow dung (20:80)
EF – *Eisenia foetida* M_2 - Coir waste: cow dung (80:20) M_4 - Coir waste: cow dung (40:60) M_6 - cow dung (100%)

Table 4: Periodical changes in total nitrogen (%) during composting of organic residues

Treatment details	30 DAI			60 DAI			90 DAI			120 DAI			150 DAI			180 DAI		
	E_1	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**
M_1	0.77	0.73	0.75	0.86	0.82	0.84	0.90	0.89	0.90	0.94	0.93	0.94	0.96	0.94	0.95	0.98	0.96	0.97
M_2	0.81	0.78	0.80	0.92	0.88	0.90	0.95	0.91	0.93	0.99	0.94	0.97	1.12	1.10	1.11	1.11	1.08	1.10
M_3	0.83	0.81	0.82	0.96	0.93	0.95	0.99	0.94	0.97	1.02	0.98	1.00	1.25	1.20	1.23	1.24	1.18	1.21
M_4	0.90	0.87	0.88	1.10	1.03	1.07	1.25	1.20	1.23	1.28	1.22	1.25	1.26	1.22	1.24	1.25	1.21	1.23
M_5	0.98	0.96	0.97	1.14	1.12	1.13	1.31	1.29	1.30	1.32	1.29	1.31	1.34	1.28	1.31	1.30	1.29	1.30
M_6	1.09	1.01	1.05	1.18	1.15	1.16	1.24	1.19	1.21	1.24	1.22	1.23	1.22	1.20	1.21	1.22	1.20	1.21
Mean	0.90	0.86		1.03	0.99		1.11	1.07		1.13	1.10		1.19	1.16		1.18	1.15	
	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E
S.E. ±	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C.D. at 5%	0.03	0.02	NS	0.03	0.02	NS	0.03	0.01	NS	0.03	0.02	NS	0.02	0.02	NS	0.02	0.01	NS

EE – *Eudrilus euginae* M_1 - Coir waste (100%) M_3 - Coir waste: cow dung (60:40) M_5 - Coir waste: cow dung (20:80)
EF – *Eisenia foetida* M_2 - Coir waste: cow dung (80:20) M_4 - Coir waste: cow dung (40:60) M_6 - cow dung (100%)

Table 5: Periodical changes in total phosphorus (%) during composting of organic residues

Treatment details	30 DAI			60 DAI			90 DAI			120 DAI			150 DAI			180 DAI		
	E_1	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**
M_1	0.18	0.16	0.17	0.23	0.22	0.22	0.30	0.29	0.30	0.32	0.31	0.35	0.35	0.34	0.35	0.40	0.38	0.39
M_2	0.21	0.19	0.20	0.25	0.23	0.24	0.32	0.30	0.31	0.34	0.32	0.33	0.45	0.42	0.44	0.44	0.42	0.43
M_3	0.23	0.21	0.22	0.26	0.25	0.25	0.33	0.32	0.33	0.38	0.37	0.38	0.49	0.47	0.48	0.51	0.45	0.48
M_4	0.24	0.22	0.23	0.30	0.27	0.28	0.40	0.37	0.39	0.49	0.47	0.48	0.50	0.48	0.49	0.50	0.47	0.49
M_5	0.28	0.24	0.26	0.42	0.36	0.39	0.55	0.52	0.53	0.55	0.50	0.53	0.56	0.50	0.53	0.55	0.49	0.52
M_6	0.35	0.29	0.32	0.47	0.42	0.45	0.54	0.48	0.51	0.53	0.49	0.51	0.53	0.49	0.51	0.52	0.48	0.50
Mean	0.25	0.22		0.32	0.29		0.41	0.38		0.44	0.41		0.48	0.45		0.49	0.45	
	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E
S.E. ±	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
C.D. at 5%	0.02	0.02	0.02	0.02	0.02	NS	0.02	0.02	NS	0.04	0.02	NS	0.02	0.02	NS	0.02	0.01	NS

EE – *Eudrilus euginae* M_1 - Coir waste (100%) M_3 - Coir waste: cow dung (60:40) M_5 - Coir waste: cow dung (20:80)
EF – *Eisenia foetida* M_2 - Coir waste: cow dung (80:20) M_4 - Coir waste: cow dung (40:60) M_6 - cow dung (100%)

Table 6: Periodical changes in total potassium (%) during composting of organic residues

Treatment details	30 DAI			60 DAI			90 DAI			120 DAI			150 DAI			180 DAI		
	E_1	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**	**E_1**	**E_2**	**Mean**
M_1	0.24	0.21	0.23	0.29	0.26	0.28	0.35	0.32	0.34	0.43	0.37	0.40	0.51	0.46	0.49	0.58	0.56	0.57
M_2	0.28	0.27	0.27	0.33	0.31	0.32	0.40	0.38	0.39	0.47	0.45	0.46	0.60	0.57	0.59	0.60	0.58	0.59
M_3	0.30	0.29	0.29	0.36	0.34	0.35	0.43	0.42	0.43	0.59	0.56	0.58	0.62	0.60	0.61	0.68	0.62	0.65
M_4	0.48	0.42	0.45	0.59	0.57	0.58	0.70	0.68	0.69	0.75	0.73	0.74	0.74	0.73	0.73	0.76	0.71	0.73
M_5	0.54	0.52	0.53	0.71	0.68	0.70	0.85	0.83	0.84	0.86	0.84	0.85	0.85	0.82	0.83	0.83	0.82	0.83
M_6	0.58	0.54	0.56	0.68	0.61	0.53	0.71	0.65	0.68	0.72	0.70	0.71	0.75	0.69	0.72	0.70	0.68	0.69
Mean	0.40	0.37		0.49	0.46		0.57	0.55		0.64	0.61		0.68	0.65		0.69	0.66	
	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E	M	E	M x E
S.E. ±	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02
C.D. at 5%	0.05	0.02	NS	0.02	0.02	NS	0.02	0.01	NS	0.02	0.02	NS	0.02	0.02	NS	0.05	0.02	NS

4. Conclusion

It can be concluded from the present investigation that amongst the various combinations of organic residues evaluated, cow dung was found the best source for rapid composting followed by 20:80 combination of coir waste and cow dung. Among the two species of earthworms, *Eudrilus euginae* species of earthworm was found superior over *Eisenia foetida* species of earthworm in respect of most of the parameters studied. As far as the manurial value is concerned, 20:80 combinations of coir waste and cow dung was found to be the best combination from the point of macro nutrient contents. The manurial value of all the compost products was improved due to vermicomposting.

5. Acknowledgement

The author is grateful to Prof. R.V. Dhopavkar and Dr. M. C. Kasture, Assistant Professor, Dept. of Soil Science and Agricultural Chemistry, College of Agriculture, Dapoli, for providing all help in this experiment.

6. References

1. Abad Noguera P, Puchades R, Maquieira A, Noguera V. Physico-chemical properties of some coconut coir dust for use as a peat substitute for containerized ornamental plants. Bioresource. Technology. 2002; 82:241-245.
2. Acharya SM. Comparative studies on physical and chemical changes during composting of organic residues as influenced by two species of earthworms and effective microorganisms. M.Sc. (Agri). Thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli. (Unpublished), 2010.
3. Bhangrath PP. Vermicomposting of organic residues by pit method. M. Sc. (Agri). Thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli. (Unpublished), 1997.
4. Bhatt VS. Handbook of Agriculture. Indian Council of Agricultural Research, 1992, 908-915.
5. Christopher PA, Viswajith V, Prabha S, Sundhar K, Malliga P. Effect of coir pith based cyanobacterial basal and foliar biofertilizer on *Basella rubra* L. Acta. Agriculture Slovenica, 2007; 89:59-63.
6. Edwards CA. Breakdown of animal, vegetable and industrial organic wastes by earthworms. In: Earthworms in wastes and Environment. Edited by C.A. Edwards, (SPB Academic publishing, Hague Netherlands.). 1988; 24:21-31.
7. Hand P, Haynes WA, Satchell JE, Frankland JC. The vermicomposting of cow dung slurry with and without Eisenia foetida, 1988.
8. Jackson ML. Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi, 1973, 134-182.
9. Jadhav VS. Studies on the physico-chemical changes during humification of organic residues as influenced by earthworms. M.Sc(Agri) Thesis submitted to K.K.V, Dapoli.(Unpublished), 1995.
10. Jadia CD, Fulekar MH. Vermicomposting of vegetable waste: A bio-physicochemical process based on hydro-operating bioreactor. African Journal of Biotechnology. 2008; 7(20):3723-3730.
11. Joshi OP, Nambiar CKB, Khan H. Effect of organic manure on some physical properties and water retention of coastal sand. Philippine J. Cocon. Study. 1982; 7(1-2):42-45.
12. Kale D. Earthworm species for degradation of organic wastes. In: vermicompost – crown jewel of organic farming. Jayanthi publication, Banglore, 2006, 17-20.
13. Kitturmath MS, Giraddi RS, Viraktamath SA, Sattigi HN. Nutrient changes during vermicomposting of agro-industrial wastes with Eudrilus eugeniae. Karnataka-Journal-of-Agricultural-Sciences. 2007; 20(3):653-654.
14. Krishnan R. Pyrolysis and combustion characteristics of saw dust, rice husk, groundnut shell and coir dust using gas chromatography. Tropical Science. 1990; 30:223-228.
15. Murali M, Bharathiraja A, Neelanarayanan P. Conversion of Coir Wastes (Cocos Nucifera) Into Vermicompost by Utilizing Eudrilus Eugeniae and Its Nutritive Values. Indian Journal of Fundamental and Applied Life Sciences. 2011; 1(3):80-83.
16. Nath G, Singh K, Singh DK. Effect of Different Combinations of Animal Dung and Agro/ Kitchen Wastes on Growth and Development of Earthworm *Eisenia foetida*. Australian Journal. Basic Applied. Science. 2009; 3:3553-3556.
17. Panse VG, Sukhatame PV. Statistical methods for Agricultural workers, ICAR, New Delhi, 1967.
18. Piper CS. Soil and Plant Analysis, Hands publisher, Bombay, 2010.
19. Rathinam P. Steps for yield increase. Survey of Indian Agriculture. 2005, 354.
20. Shinde PH, Naik RL, Nazirkar RB. Evaluation of vermicompost Proc. National seminar on Organic farming held at College of Agril. Pune, 1992, 18-19.
21. Sudhira HS, Jacob A. Reuse of by-products in coir industry. Proc. Internet conference on material Flow Analysis of Integrated Bio Systems, 2000.
22. Sujit Adhikary. Vermicompost the story of organic gold: A Review. Agricultural Sciences. 2012; 3:7.
23. Tanushree Mondal, Jayanta Kumar Datta, Naba Kumar Mondal. Chemical fertilizer in conjunction with biofertilizer and vermicompost induced changes in morpho-physiological and bio-chemical traits of mustard crop. Journal of the Saudi Society of Agricultural Sciences. 2015; 16:135-114.
24. Talashilkar SC, Bhangrath PP, Mehta VB. Changes in chemical properties during composting of organic residues as influenced by earthworm activity. Journal of Indian Society of Soil science. 1996; 47(1):50-53.
25. Tripathi G, Bhardwaj P. Decomposition of kitchen waste amended with cow manure using an epigeic species (*Eisenia foetida*) and an anecic species (*Lampito mauritii*). AU: Bioresource-Technology. 2004; 92(2):215-218.