IJPS INTERNATIONAL JOURNAL OF PLANT SCIENCES
e ISSN-0976-593X Volume **12** | Issue 2 | July, 2017 | 139-148

DOI: 10.15740/HAS/IJPS/12.2/139-148
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RESEARCH ARTICLE

Production of vermifertilizer from sugar industry wastes by using vermicompost epigenic earthworm

■ **MUTHUKRISHNAN BOOPATHIAYYANAR** AND **SWAMINATHAN PRABAKARAN**

SUMMARY

The efforts have been made to convert the sugar industry waste into a value-added product, by employing an epigenic earthworm species for vermicomposting eg. *Eisenia foetida*, under laboratory conditions. Sugar industry waste was amended with other organic supplements (Cow dung); and ten types of vermicompost were prepared. Vermicomposting of sugar industry waste resulted in total organic carbon (22.10±0.171) but increment in total nitrogen (20.16±0.142), total potassium (16.76±0.111) and total phosphorus (19.39±0.101) was achieved after 14 weeks of *E. foetida* activity. The C:N ratio decreased with time in all the earthworm worked vermicompost in the range of (1.09±0.110). *E. foetida* exhibited maximum value of mean biomass gain (1091.54±0.481 mg earthworm^{-1}), cocoon numbers (0.80±0.014 cocoon worm^{-1} day^{-1}) in VC_4 treatment. The microbial populations in vermicomposting (VC_4) were enumerated with the dilution plate method, using several media in the presence of earthworms. The microbial populations increased due to earthworm activity. Overall, VC_4 vermicompost appeared as an ideal substrate to manage sugar industry waste effectively and these method can be proposed as a low impute basic technology to convert sugar industry waste into value added vermicomposts.

Key Words : Cow dung, Earthworm, *Eisenia foetida*, Press mud, Waste, Sugar industry

How to cite this article : Boopathiayyanar, Muthukrishnan and Prabakaran, Swaminathan (2017). Production of vermifertilizer from sugar industry wastes by using vermicompost epigenic earthworm. *Internat. J. Plant Sci.*, **12** (2): 139-148, **DOI: 10.15740/HAS/IJPS/12.2/139-148**.

Article chronicle : Received : 24.02.2017; **Revised :** 30.04.2017; **Accepted :** 18.05.2017

The present society, with its high population densities, dense industrial development and serious methods of agriculture has produced ever increasing quantities of solid wastes. The sugar cane industry generated large quantities of recyclable organic materials. Sugar is mainly manufactured from sugar-cane and beet-root (Khwairakpam and Bhargava, 2009). Sugarcane by-products such as bagassese and molasses have been observed for their potential as fertilizer, with positive results. Press mud is another sugarcane by-product. Even though press mud has been used as a fertilizer in agriculture (Keshavanath and Gangadhara, 2006), these waste disposal is becoming one of the main areas of concern for a developing country's like India.

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
SWAMINATHAN PRABAKARAN, Department of Botany, Annamalai University, Annamalai Nagar, CHIDAMBRAM (T.N.) INDIA
Email : drprabakarans@gmail.com

Address of the Co-authors:
MUTHUKRISHNAN BOOPATHIAYYANAR, Department of Botany, Annamalai University, Annamalai Nagar, CHIDAMBRAM (T.N.) INDIA
Email : boopathiayyanar@gmail.com

Presently, a very manger quantity of the filter press mud is usually applied as fertilizer source and soil conditioner, or it is returned to sugarcane cultivated fields. However, this approach is not desired practice in view of the odour from biological degradation (Tsai *et al.*, 2003). Presented literature has verified that application of un-decomposed wastes or non-stabilized compost to land may lead to restriction of plant nutrients as well as cause phytotoxicity (Butler *et al.*, 2001). Vermiconvertion and their application also helps in cost effective and also efficient recycling of animal wastes, agricultural residues and industrial wastes. The biochemical decay of organic matter is primarily accomplished by micro-organisms, but earthworms are critical drivers of the processed as they are involved in the stimulation of microbial populations through fragmentation and ingestion of fresh organic matter, which outcomes in a greater surface area available for microbial colonization, thereby harshly altering biotic activity (Domínguez *et al.*, 2010). Some of this material will be digested, but worms also excrete enormous amounts of casts that contain different nutrient and microbial populations than those contained in the material prior to consumption (Haynes *et al.*, 2003 and Knapp *et al.*, 2009). Therefore, the vermicomposting practise includes two dissimilar phases as regards the activity of earthworms: (i) An active phase during which earthworms practise the organic waste, thereby transforming its physical state and microbial composition (Lores *et al.*, 2006) and (ii) A maturing like phase marked by the movement of the earthworms towards fresher layers of undigested waste, during which the micro-organisms take over the decomposition of the waste processed by the earthworms (Aira *et al.*, 2007). The chemical analysis high organic matter content (or) OC, pH, buffer capacity, nitrogen and phosphorus level and low concentration of press mud and organic pollutants have revealed that sugar mill sludge may be utilized as a soil amendment, improving soil fertility (Zhang *et al.*, 2004) but stabilization involving decomposition of an organic waste to the extent that biological and chemical hazards are eliminated in required (Benito *et al.*, 2003; Suthar, 2011 and Gomez-Brandon *et al.*, 2011). The investigation of the present study was to stabilize primary sludge from a treatment unit of a sugar mill using the epeginic earthworm species, *Eisenia foetida*. The dried sugar mill sludge of press mud was mixed with cow dung at different ratios in order to optimize the waste mixture for better decomposition. The changes in physico chemical and microbial parameters of waste materials were measured. *E. foetida* cocoon and hatchling production patterns in different waste mixture were also monitored during vermicomposting process. The role of earthworms in vermicomposting of cow dung and press mud. It was hypothesized that not only the worm growth and reproduction depend on the food type and amount, but also the vermicomposting quality. So in this study, an attempt is being done to investigate the role of earthworms in vermicomposting of cow dung and press mud.

MATERIAL AND METHODS

Earthworm (EW) :

Eisenia foetida collected from the Sakthi Farm House, Erode, Tamil Nadu, India. Healthy unclitellated hatchlings weighing 200 – 250mg live weight were randomly picked up for the experiment from the stock culture maintained by Botany department, Annamalai University, Chidambaram, Cuddalore, India.

Cow dung (CD) and Solid sugar mill waste (SSMW):

Fresh cow dung was collected from an Agricultural farm house, Faculty of Agriculture, Annamalai University, Cuddalore, India. The main physico-chemical characteristics of CD were pH: 9.1±0.28, Ec : 3.9 ± 0.24 ms cm^{-10}, TOC : 234.55 ± 0.31g/kg, TN : 11.76 ± 0.23g/kg, TP : 3.17 ± 0.19g/kg, TK : 16.4 ± 0.67g/kg, C:N ratio : 19.95 ± 0.19, etc., Solid sugar mill waste (SSMW) press mud procured from a waste material treatment plant of a sugar mill (E.I.D Parry Sugar Mill Pvt. Ltd.) located in Cuddalore (India). The main characters of SSMW were pH: 7.7±0.29, Ec : 6.63 ± 0.17 ms cm-10, TOC:189.21±0.25, TN: 18.89±0.22, TP:7.22±0.22, TK:18.3±0.53, C:N ratio: 10.02±0.27, etc. It was dried in shade before vermicompost and all the wastes were used on dry weight basis by oven drying at 110ºC to constant mass. The main physico-chemical analysis of air dried press mud and cow dung in the study is shown in Table A.

Experimental setup :

Ten different ratio vermicomposts units were established having different ratios of cow dung (CD) and press mud (PM). Dried PM and CD were mixed to obtain the following substrates; VC_1 PM (0%) + CD (100%) Control, VC_2 PM (10%) + CD (90%), VC_3-PM (20%) + CD(80%), VC_4-PM (30%) + CD (70%), VC_5-

Table A: The main physico-chemical analysis of air dried press mud, cow dung

Parameters	pH	Electrical conductivity (EC) ($mScm^{-1}$)	Moisture content	Total organic carbon (TOC) (g/kg)	Total nitrogen (TKN) (g/kg)	Total phosphorus (TP) (g/kg)	Total potassium (TK) (g/kg)
Cow dung	9.1±0.28	3.9±0.24	33.69±0.17	234.55±0.31	11.76±0.23	3.17±0.19	16.4±0.67
Press mud	7.7±0.29	6.63±0.17	55.78±0.16	189.21±0.25	18.89±0.22	7.22±0.22	18.3±0.53

Table 1 contd…

Parameters	Total calcium (TCa) (g/kg)	Total sodium (TNa) (g/kg)	C/N ratio	Iron (Fe) (mg/kg^{-1})	Zinc (Zn) (mg/kg^{-1})	Manganese (Mn) (mg/kg^{-1})	Copper (Cu) (mg/kg^{-1})
Cow dung	1.82±0.10	2.89±0.32	19.95±0.19	1.87±0.13	4.91±0.52	4.14±0.47	1.86±0.44
Press mud	2.182±0.01	4.289±0.01	10.02±0.27	21.45±0.34	10.57±0.64	10.96±0.52	3.8±0.40

PM (40%) + CD (60%), VC_6-PM (50%)+CD (50%), VC_7- PM (60%) + CD (40%), VC_8-PM (70%) + CD (30%), VC_9-PM (80%) + CD (20%), VC_{10}-PM (90%) + CD (10%). The Potential of Hydrogen (pH) and electrical conductivity (EC) were determination using a water suspension each waste in the ratio 1:10 (w/v) that be necessary agitated mechanically for 30min and filtered done Whatman filter paper No 1. The total organic carbon (TOC) was measured using the method of Nelson and Sommers (1982). The moisture content and humus of the soil was determinates by the standards of (Thorex *et al.*, 2008). Organic carbon, Phosphate, nitrogen and potassium in the soil sample were analyzed by using a soil analysis kit (Jyoti Scientific, India). OC was estimated by chromic acid wet digestion method of Walkley and Black (1934). The levels of total nitrogen (TN) present in the samples were estimated using Kjeldhal method of Jackson (1973). The levels of total phosphorus (TP) present in the organic samples were estimated using ammonium phospho-molybdate method of Pemberton (1945). The levels of total potassium (TK) present in the organic samples were estimated by using Flame photometry method of Stanford and English (1949). The ratio of the percentage of carbon to that of nitrogen (C/N ratio) was arrived at by dividing the percentage of carbon with the percentage of nitrogen estimated in the given organic sample. 1000g (dry weight basis) of each feed mixture were filled in an earthen pot (Size) on dry weight basis and each vermicompost was established in triplicate. During the study period, no extra feed was added at any stage. These feed mixtures were turned over manually every 24h for 15 days, 10 non – clitellated earthworms were introduced in each container. The moisture content of the feed in each container was maintained at 60 – 70 per cent. Growth, clitellum development and cocoon production were measured weekly for 11 weeks. The feed in the container turned out, and earthworms and cocoons were separated from the field by hand shorting, after which they were counted, examined for hatching development and population. Then all measured earthworms and the feed were returned to the container. The hatches of cocoons and the number of hatchlings were studied by incubating the cocoons at 25ºC in glass-dishes in double distilled water as defined by Venter and Reinecke (1988), at the end of vermicomposting period the earthworms and cocoons were separate and the final vermicomposting from each reactor was air dried at room temperature. The sieving of final vermicomposting was grounded in a steel blade, stored in airtight plastic vials for further chemical analysis.

Microbial analysis of vermicompost :

Total actinomycetes, bacterial and fungal population were analyzed as described by Aneja (2004). One gram of material from each type of waste mixture was transferred to autoclaved test tubes containing sterilized double distilled water (DDW) and mixed thoroughly using horizontal shaker for 30 mins. The mixture was silted serially and 1-ml aliquots were pour-plated in ken knight's medium (glucose, 1.0g; $NaNO_2$,0.1g; K_2HPO_4,0.1g; $MgSO_4.7H_2O$, 0.1g; $(NH_4)_2SO_4$, 0.1g; agar, 15.0g per 1 litre DDW), Nutrient agar (agar, 20.0g; peptone, 10.0g; NaCl, 5.0g per 1 litre DDW) and Rose Bengal agar (dextrose, 10.0g; Peptone, 5.0g; K_2HPO_4, 1.0g; $MgSO_4.7H_2o$, 0.5g; Rose Bengal, 0.5g; agar, 15.0g per 1 litre DDW). The culture plates were incubated for 24hr, 72hr and one week, respectively to count the CFUs (Colony Forming Units) of actinomycetes, bacteria, and fungi, respectively.

Statistical analysis :

One way ANOVA was used to analyses the differences between treatments. A Duncan test was also performed to identify the descriptive types of the data sets. SPSS statistical package (Windows version 22.0) was used for data analysis. All statements reported in this study are at the $p<0.05$ levels.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Eisenia foetida growth and reproduction :

Eisenia foetida didn't accept the 100 per cent Press mud as feed. The addition of some organic waste such as cow dung was necessary for the survival of the earthworms in press mud. No mortality was observed in any of the studies feed mixes during the observation period. The maximum earthworm biomass were observed in the VC_4 (1091.54±0.483) mg earthworm^{-1}) and the minimum was VC_{10} (779.42±0.521 mg earthworm^{-1}) press mud feed mixture. The increase proportion of the press mud in their feed mixture promoted a decrease in biomass of *E. foetida*. Net biomass gain by earthworm in VC_4 (70%CD+30%PM) was fold higher than different press mud contains feed mixtures.

A comparison of worm biomass in all the experiments the observation that replacement of cow dung by press mud has minimum effect of insect biomass. The overall effect was that cow dung can be a replaced of press mud without affecting the worm growth pattern. The cocoon production by *E. foetida* in different feed mixture, cocoon production was started in the 4th week in VC_1, VC_2, VC_3, VC_4, VC_5 in 5th week in feed mixture no's VC_6, VC_7, and in 6th week in feed no's VC_8, VC_9, VC_{10}. After 13 weeks maximum cocoon (0.80±0.014) was counted in VC_4 and the minimum (0.15±0.028) in the VC_{10} Press mud feet. The average number of cocoon production was between 0.15±0.028 (10%CD+90%PM) and 0.80±0.014 (70%CD+30%PM) Cocoon earthworm^{-1} for different feed mixtures tested. The mean number of cocoon produced per worm per day was (0.80±0.141) in VC_4, which was 5 fold greater than (0.15±0.028) VC_{10}. Cocoon produced per worm per day in VC_{10} (10% CD + 90% PM) press mud feed mixture. The results showed that cow dung amended with 70 per cent press mud can be a suitable growth medium for *E. foetida* Fig. 1. The greater percentage of press mud in these mixtures significantly affected the biomass and cocoon production. The end of the results suggests that feed no's VC_{10}, VC_9, VC_8, VC_7 Fig. 1 cannot be used as substrate for vermicompost by *E. foetida* but must be supplemented with more cow dung.

Physico chemical of feed mixture and vermicompost:

There was a shift in the pH values towards alkaline (8.7±0.171) from the initial pH (7.1±0.355) in all the feed mixtures.The TOC content of initial were in the range of 25.08±0.138 (10%CD+90%PM) 30.46±0.113 (30%CD+70%PM). TOC content was decreased with increase in PM contend of the feed mix and large fraction of TOC was lost as CO_2 in all the vermicomposter by the end of the vermicomposting. TOC loss was highest in VC_3 (22.10±0.17) and lowest in VC_{10} (17.56±0.25). Total nitrogen (TN) was greater in final products than the initial feed mixture. The TN content ranged from 8.47±0.237 (20% CD+80% PM) 11.23±0.115 g/kg (30% CD+70% PM). Total TN content decreased with increase in PM content in the different feed mixture. The TN content was 18.93±0.141, 18.77±0.123, 19.36±0.410, 20.16±0.142, 18.82±1.53, 18.52±0.247, 18.42±0.141, 17.61±0.161, 16.43±0.253 and 15.74±0.118. The TN content was 1.97, 2.03, 1.89, 1.79, 1.96, 1.92, 2.02, 2.01, 1.94 and 1.86 times higher in vermicompost VC_1 to VC_{10}, respectively, than initial content. The vermicomposter waste mixture showed statistically significant different among treatment for Total P Contents. A compared to the initial level, the total P level increased by 1.76, 1.77, 1.73, 1.88, 1.75, 1.71, 1.64, 1.61, 1.56 and 1.57 fold after vermicomposting. Similarly, the concentaltion of total P in vermicomposted material was in the range of 12.70-19.39 mg/kg. The total potassium content was 1.95, 2.43, 2.12, 1.93, 2.17, 2.22, 1.99, 1.95, 1.98 and 2.06 fold after vermicomposting. The TK content in vermicomposter VC_4 was higher than all other vermicomposter. The minimum C: N ratio was 2.72±0.017 (30%CD+70%PM). The maximum C: N ratio was 3.22±0.321 (VC_8). The phosphorus content reduced from 10.25±0.161 to 7.88±0.165. The C:N ratio decreased significantly by the end of experiment Fig. 2 and the statistically significant ($P<0.005$). Traditionally C:N ratio is considered to be an important indicator of compost maturity and it quality. In comparison to initial values there was a 60-79 per cent decrease in the C:N ratio of the waste mixture. TN content is PM contain feed mixture lover than Cow dung, hence C:N ratios were higher than CD Fig. 2. The C: N ratio, one of the

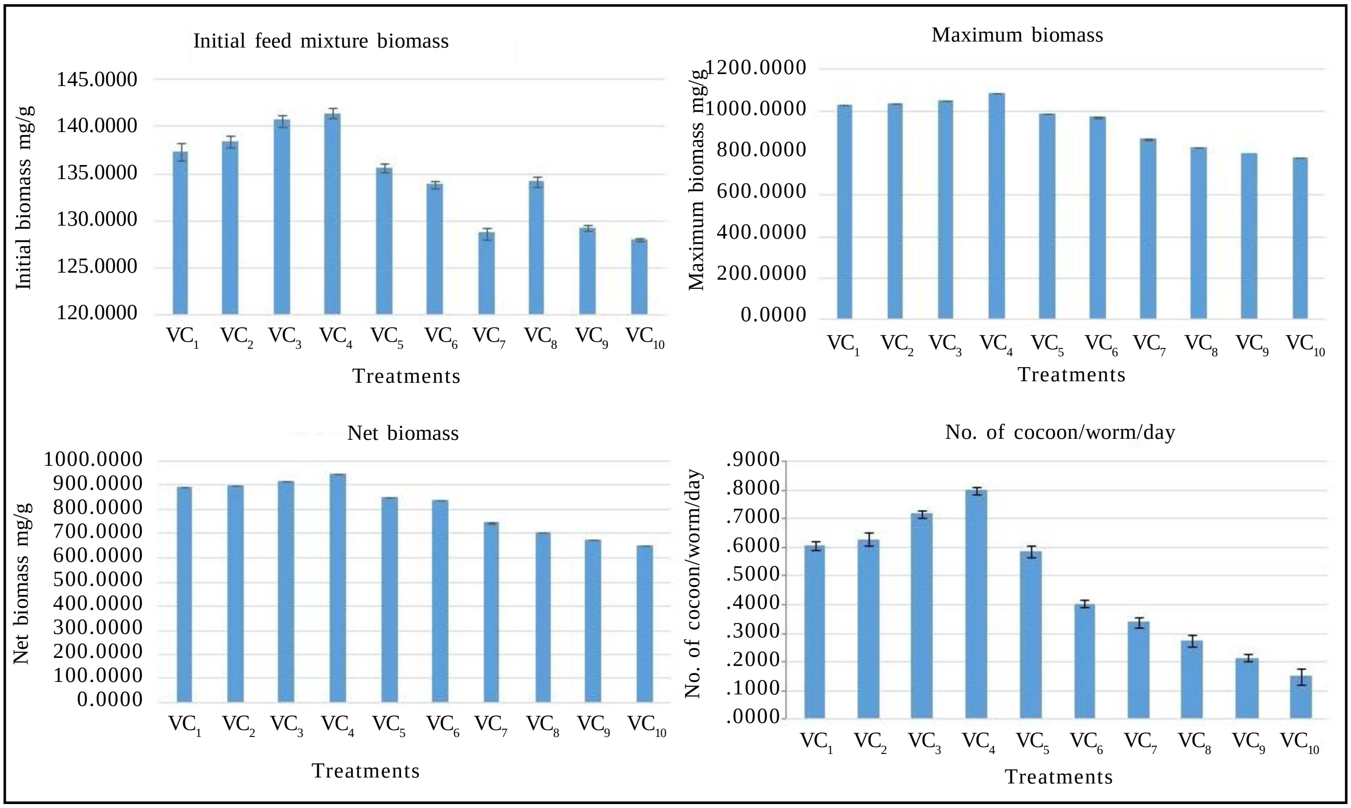

Fig. 1 : ***Eisenia foetida*** **biomass production**

most widely used indices for maturity of organic wastes, decreased with time for all the feed mix initial C and N was in the range of 2.71±0.017 – 3.22±0.321. Exceptionally higher C: N ratio in presumed contain. The mixture can be attributed in initially lower content of the nitrogen in their feeds. Final C: N ratios were in the range of 1.04±0.015 – 1.17±0.012.

Microbiology of vermicompost materials :

The initial feed mixtures showed lower microbial population that the vermicomposte materials (Fig. 3). The vermicompost wastes were mixtures from different treatments did not show statistically significant difference for microbial population. There was positive impact of vermicomposting process on population of actinomycetes in earthworm worked materials (Fig. 3a). CFU as compared to initial level, there was a 3.85-to 5.98- fold increase actinomycetes counts after vermicomposting. Actinomycetes are found to be one of the most dominant (Ravasz *et al.,* 1987). Earlier studies have also shown a greater population of actinomycetes in earthworm-worked materials at the end of vermicompost (Prakash and Karmegam, 2010; Paul *et al.,* 2011 and Negi and Suthar, 2013). There was a 2.19-to 3.5-fold increase in the total bacterial counts in waste mixture feed stocks after vermicomposting with *E. foetida* (Fig. 3b). No consistent relationship between bacteria counts and sugar mill sludge concentration was observed. The maximum fold increase was observed in 90 per cent sugar mill sludge.

Increase in bacterial populations during vermicompostion hace also been reported by previous studied researchers (Prakash and Karmegum, 2010; Pramanik *et al.,* 2007; Sing and Suthar, 2012; Negi and Suthar, 2013). The vermicomposting caused significant impact on fungal richness of the composted materials at the end of process (Fig. 3c), as was also observed by others during vermicomposting of different organic wastes (Pramanik *et al.,* 2007; Johnpaul *et al.,* 2011; Pramanik and Chung, 2011; Singh and Suthar, 2012 and Negi and Suthat, 2013). In the present study vermicomposting caused 1.89-to 3.00-fold an increase in fungal colony counts were recorded in sugar mill sludge spiked with cow dung. Maximum counts were recorded in sugar mill sludge (VC_{10}), possibly due to the sugar rich nature of this substrate.

Earthworms are soil invertebrates that play a key role in the physical and chemical properties of soil

(Satchell and Martin, 1984). In a majority of the temperate regions, though a large number of species are organic matter or litter feeders, *E. foetida* for its ability to adapt different organic decomposable wastes, short life cycle and high fecundity and owing to its tolerance to density, pressure, has been the most preferred earthworm for culturing practices (Hartenstein and Bisesi, 1989 and Edwards, 1995). The present findings on the status of

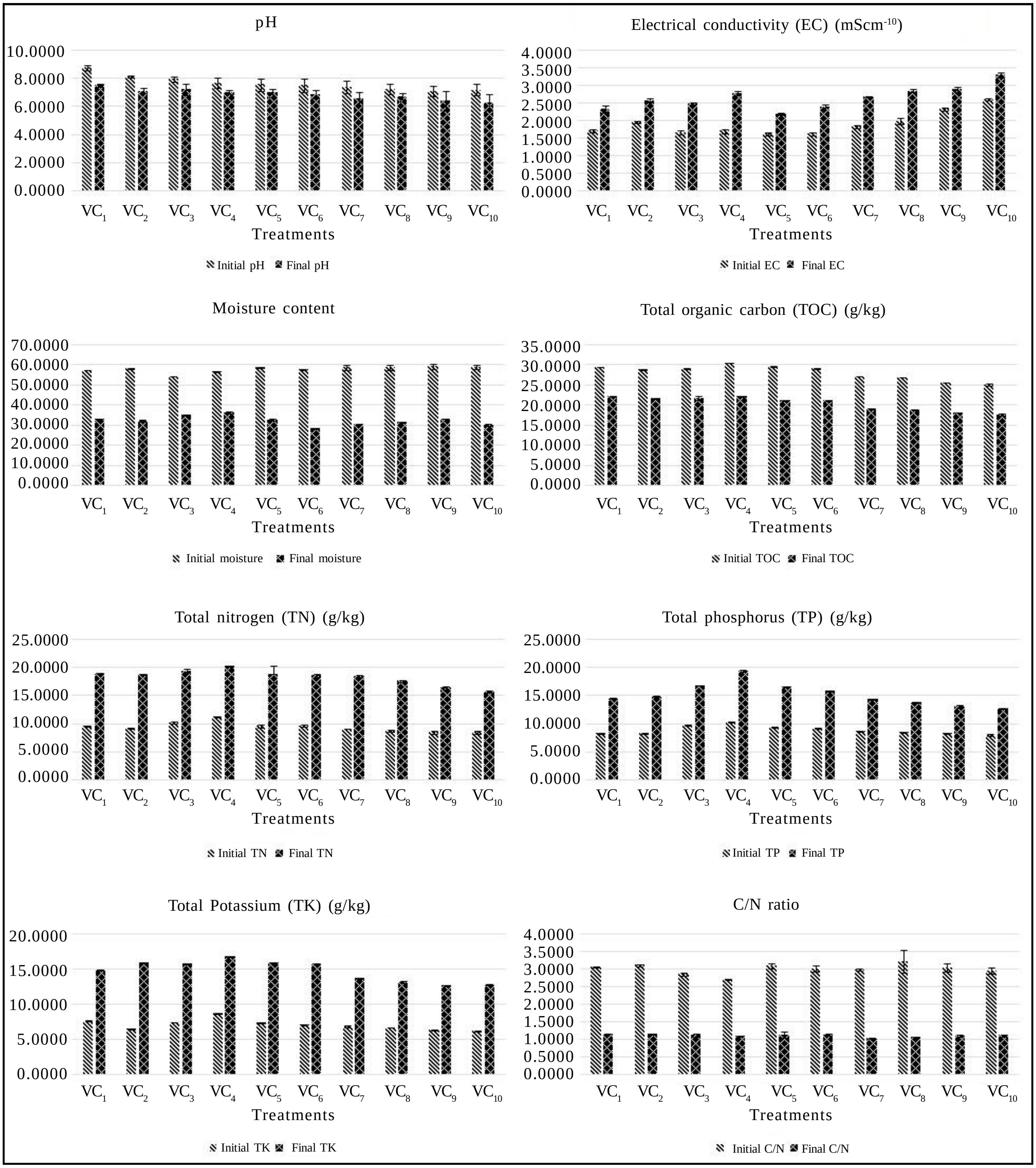

Fig. 2 : Physico-chemical of initial feed mixture and vermicomposts

physicochemical parameters like pH and moisture content in *E. foetida* corroborate with the results of Chhotaray *et al*. (2011) who also reported a similar increase in the value of pH and moisture in hind region and fresh cast of *Glyphodrillus tuberosus*. The results also fortify the hypothesis of Trigo and Lavelle (1995) who outlined that organic waste ingested by the worm get enriched with large amounts of mucus and water in the anterior gut, while the pH is neutralized. Padmavathiamma *et al.* (2008), have reported that the pH of vermicompost ranged from neutral to alkaline, where as it was acidic for conventional compost. Other workers have also reported similar observations (Mitchell, 1997; Gunadi and Edwards, 2003; Ndegwa *et al*., 2000 and Atiyeh *et al*., 2000). The pH shift towards acidic conditions was attributed to mineralization of the nitrogen and phosphorus into nitrites/nitrates and orthophosphates: bioconversion of organic materials into intermediate species of organic acids (Ndegwa *et al.*, 2000). The processes results in an activation of microflora, which further digests the organic matter in the middle and posterior parts of the gut. Earthworm for their growth and reproduction, have been shown to meet their nutritional requirements by feeding on organic matter and microbes (Parthasarathi and Ranganathan, 2000) the latter constituting an important nutritional component in the diet (Edwards and Bohlen, 1996). Wong et al reported that a gradual increase in EC was observed with increase in decomposition time and it might due to the loss of weight of organic matter and release of different mineral salts in available forms. pH and EC are limiting factors on the growth and development of *E. fotida* (Edvards, 1999). However, Karmegam and Daniel (2009), reported an increase in EC during vermicomposting, which is due to the increase of soluble salt level resulting from the mineralization by worms and the microbes existing in the earthworm gut and the organic matter.A large fraction of TOC was lost as CO_2 in all the vermicomposter by the end of the vermicomposting TOC loss was highest in VC_4 (22.10±0.17) and lowest in VC_{10} (17.56±0.25). Total nitrogen (TN) was greater in final products than the initial feed mixture. The TN content was 1.97, 2.03, 1.89, 1.79, 1.96, 1.92, 2.02, 2.01, 1.94 and 1.86 times higher in vermicompost VC_1, VC_2, VC_3, VC_4, VC_5, VC_6, VC_7, VC_8, VC_9, VC_{10}, respectively, than initial content. The incorporation of floral waste vermicompost has been shown to increase organic carbon content in the soil (Nelson and Sommers, 1982). Increase in the level of total organic carbon may be due to the addition of earthworm's cast, which is rich in carbon or due to the presence of high amount of organic matter in waste (Kaviraj and Sharma, 2003) and feeding action of earthworms and decomposition by microbes. The combined process brings about carbon loss from substrates in the form of carbon dioxide. The microbial respiration may lead to rapid carbon loss through CO_2 production and also, digestion of carbohydrates, lignin, cellulose and other polysaccharides from the substrates by inoculated earthworms may cause carbon reduction during the decomposition of organic waste (Kaushik and Garg, 2003; Suthar, 2007 andVenkatesh and Eevera, 2008). The total potassium (TK) content in vermicomposter number 4 was higher than all other vermicomposter. The TK content was 1.95, 2.43, 2.12, 1.93, 2.17, 2.22, 1.99, 1.95, 1.98 and 2.06 times higher in

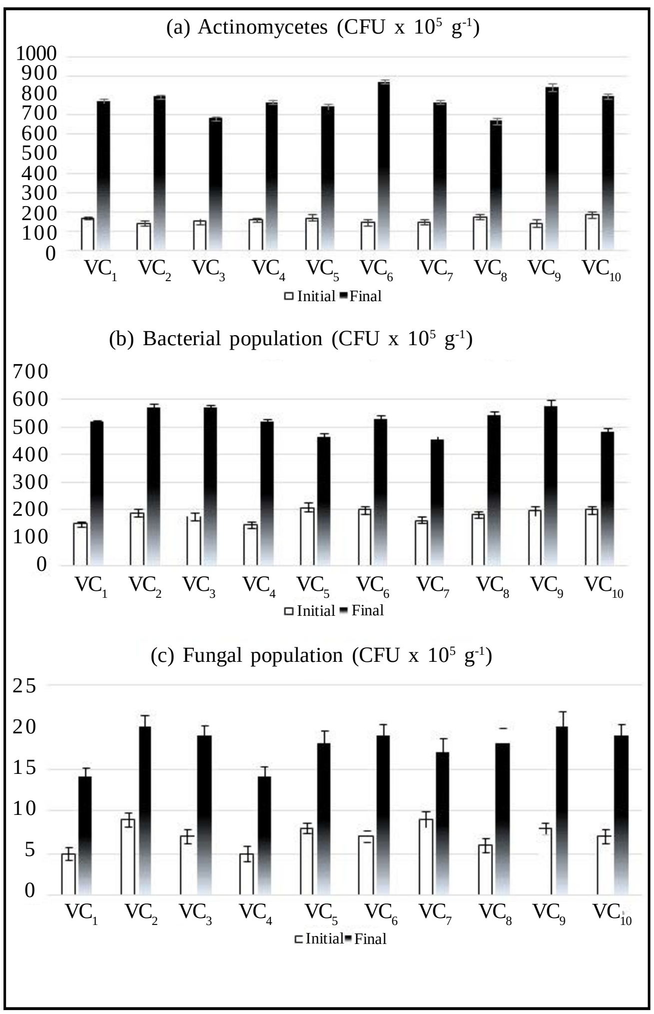

Fig. 3 : Initial feed mixture and final vermicomposte microbial population

vermicompost VC_1, VC_2, VC_3, VC_4, VC_5, VC_6, VC_7, VC_8, VC_9, VC_{10}, respectively, than initial content. Vermicomposting has been established as an effective process for recovering higher K from organic waste (Manna *et al.,* 1997 and Suthar, 2007). The generation of acid during decomposition of organic matter by the micro-organisms is the crucial process for solubilization of insoluble potassium (Adi and Noor, 2009). The change in the distribution of potassium between exchangeable and non exchangeable forms may lead to an increase in the potassium content in the vermicompost. The earthworm processed the waste material which contained high concentration of exchangeable potassium, due to enhanced microbial activity during the vermicomposting process and it consequently enhanced the rate of mineralization (Achsah and Prabha, 2013). The vermicomposter waste mixture showed statistically significant different among treatment for total phosphorus (TP) level increased by 1.76, 1.77, 1.73,1.88, 1.75, 1.71, 1.64, 1.61, 1.56 and 1.57 fold after vermicomposting. Similarly, the concentration of TP in vermicomposted material was in the range of 12.70 – 19.39 mg kg^{-1}. The C/N ratio decreased significantly by the end of the experiment Fig. 2 and the different among different ratiowaste mixture was statistically significant ($P<0.005$). Traditionaly C/N ratio is considered to be an important indicator of compost maturity and in quality. In comparison to initial values there was a 60 – 79 per cent decrease in the C/N ratio of the waste mixture. The increase in amounts of nitrogen and decrease in carbon content (reduced C: N ratio) is an indication of increased mineralization of the elements due to enhanced microbial and enzymatic activities in earthworm gut (Parthasarathi and Ranganathan, 2000). The C:N ratio of vermicompost in the current studies was found to be 17.489 as compared to 46.6 of soil. These results are in accordance with the results of Mistry *et al.* (2015). Similar results of C: N 15.54 and 16.03 in the vermicompost obtained from vegetable wastes are present (Kapoor *et al.*, 2015). Vermicompost obtained from flower waste has C: N ratio 12.3 (Kohli and Hussain, 2016) while temple waste vermicompost has C: N ratio 19.36 (Singh *et al.,* 2013), 17.38 (Chakole and Jasutkar, 2014) and 21.55 (Jain, 2016). C: N ratio is one of the most widely used indicators of vermicompost maturation, which declines during the vermicomposting process (Kale, 1998; Gupta and Garg, 2008 and Suthar, 2008). Decrease in the C: N ratio in vermicompost to less than 20 indicates an advanced degree of organic matter stabilization and mineralization (Senesi, 1989). According to Morais and Queda (2003), a C/N below 20 is indicative of acceptable maturity and a ratio of 15 or lower in preferable for agronomic use of composts.

Conclusion :

In the present study the vermicomposting of Press mud spiked with cow dung with *E. foetida* has been examined for its suitability for growth and reproduction of earthworms and physio-chemical parameters. The earthworms didn't feed on raw Press mud accepted it's as a diet only when cow dung was spiked with it. If Press mud is mixed with cow dung upto 50 per cent, the physico-chemical quality of the vermicompost is not affected, but a higher percentage of Press mud in the feed mixtures retards the growth and fecundity of earthworms. The result also revealed that earthworm growth was affected negatively by the presence of toxic chemical substrates.

Acknowledgement :

The author is thankful to University Grants Commission, New Delhi (India) for providing financial assistance in the form of Junior Research Fellowship to lead this study.

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