Iran. J. Environ. Health. Sci. Eng., 2009, Vol. 6, No. 3, pp. 201-208

EFFICIENCY OF COMPOSTING PARTHENIUM PLANT AND NEEM LEAVES IN THE PRESENCE AND ABSENCE OF AN OLIGOCHAETE, *EISENIA FETIDA*

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Received 12 February 2009; revised 1 June 2009; accepted 29 July 2009

ABSTRACT
Parthenium plants and neem leaves were composted using the epigeic earthworm, *Eisenia fetida* (worm-worked compost) to study the growth and reproductive indices of earthworm involved in the process of composting. Similarly, parthenium plants and neem leaves were composted without worms (worm-unworked compost). Efficacy of the resulting composts in supporting the growth of plant was tested with the germination and growth of *Vigna radiate* seedlings. The results showed that higher parthenium amendment significantly reduced the growth and reproduction of *Eisenia fetida* compared with control. The two-way ANOVA results showed a significant difference in the growth rate of worms when exposed to different amended concentrations of parthenium plants and neem leaves at different durations as fixed factors. The following compost parameters were not significantly different when compared with control: pH, nitrogen, phosphorus, iron for parthenium worm-worked compost; nitrogen, phosphorus, magnesium, iron, organic carbon and carbon/nitrogen ratio for neem worm-worked compost; nitrogen, phosphorus and organic carbon for parthenium worm-unworked compost and pH, nitrogen, phosphorus, zinc and carbon/nitrogen ratio for neem worm-unworked compost. Between parthenium plant composts and neem leaves composts, significant differences were not observed in any of the plant biometric parameters. The results obtained from the present study indicated that the parthenium composting at low amendments with cow dung may help its eradication for better utilization.

Keywords: *Eisenia fetida,* Neem leaves, Parthenium plant, Vermicompost

INTRODUCTION
The vermicomposting process is a result of the combined action of the earthworms and microflora living in earthworm intestines and in the growth medium. Vermicompost improve the soil structure, increasing the water holding capacity and porosity which facilitate the root respiration and growth (Lee, 1992; Parthasarathi *et al.,* 2008). The beneficial effects of vermicompost on crops like maize (Gutierrez-Miceli *et al.,* 2008), wheat (Sharma and Madan, 1988), strawberry (Singh *et al.,* 2008), petunias (Arancon *et al.,* 2008), marigold, pepper, cornflower, tomato (Bachman and Metzger, 2008), blackgram (Parthasarathi et al., 2008) and pepper (Arancon *et al.,* 2004) have already been reported. Sugar factory waste (Lakshmi and Vijayalakshmi, 2000), pig solids (Dominguez and Edwards, 1997) and sludge (Alidadi *et al.,* 2005; Parvaresh *et al.,* 2004) could all be converted into good quality soil addition along with the biomass production of earthworms. Epigeic earthworms like *Eudrilus eugeniae*, *Eisenia foetida* and *Perionyx excavatus* are the most popularly used species for vermicomposting (Kale *et al.,* 1982 and Neuhauser *et al.,* 1988).

Parthenium hysterophorus Linn. is an exotic weed which has become naturalized and which is spreading at an alarming rate all over India. The plant was introduced in 1956 from seeds present in wheat received from Mexico under the PL-480 scheme of the US Government. This

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plant, popularly known as congress grass, is a defamed plant in view of its toxic and allergic properties, since it causes health problems to man and domestic animals. At present, it is one of the most troublesome weeds in India, spreading rapidly in forests, pastures and agricultural lands. Several attempts have been made for its prevention, eradication and control, but to date without success (Kavita and Nagendra, 2000). Hence, huge quantities of this weed are annually produced in India, but its economic use as food source is impaired by its toxicity. This is why vermicomposting might be a useful alternative to convert biomass from this species to a useful material that could be used as soil conditioner.

The neem tree (*Azadirachta indica* A. Juss) is distributed throughout India. Almost all parts of the tree are used for medicinal purposes (leaf and fruit extract, neem oil, neem oil cake or fruit). Many neem seed products (such as oil, cake extracts and purified fraction) have been intensively tested against a large number of insect species in view of insecticidal properties of neem leaves extracts (Saxena, 1987), and presenting an important potential for insect control (Fagoonee, 1981). The interest of using neem leaves in this study because this tree swayed in the autumn breeze eventually leaves were accumulated in soil.

The present work brings out another dimension of the potential use, as raw material for vermicomposting, of different plant waste materials produced in India in order to obtain materials usable as soil conditioner. The work also encompasses effects of parthenium plant and neem leaves on the growth and reproductive indices of the earthworms used in the process of composting. The suitability as soil amendment of the vermicomposts produced was assessed studying the growth of *Vigna radiata* L., Wilczek.

MATERIALS AND METHODS

Experimental design

The earthworm *Eisenia fetida* was purchased from the Bangalore University of Agricultural Sciences (India) and cultures were maintained in the laboratory over a period of two years with cow dung as the substrate and food. Leaves of neem plant (*Azadirachta indica* A. Juss) and parthenium (*Parthenium hysterophorus* Linn) plants collected from the Bharathiar University campus were washed, shade dried, and cut into pieces of 3-4 cm length. The substrates for vermicomposting were prepared by mixing 50 (P1), 75 (P2) and 100 g (P3) of parthenium or neem leaves (N1, N2 and N3) with a fixed quantity of cow dung (500 g) in plastic containers. Controls consisted on 500 g of cow dung (C). Control and treatments were replicated six times. The moisture content of the substrate was maintained at 60–65% for a period of 15 days to facilitate preliminary decomposition of materials. After that period, in half of the replicates (n=3) 10 adult worms were added to each container, which corresponded to the worm-worked composts (WC). The other half of replicates (n=3) corresponded to the worm-unworked composts (WU). The processes of vermicomposting (WC) or composting (WU) were allowed to take place under laboratory conditions (27 ± 2^{0} C) with natural day light cycle.

Growth and reproduction of worm

After an undisturbed 7 days composting period, the content in the replicates was mixed, and moisture content was checked together with earthworms' activity. Every 15 days over a period of 45 days, the worms were hand sorted and weighed. The weight of the 10 worms were taken together (in mg) and calculated to percentage of single worm weight. Cocoons were harvested weekly, placed in distilled water in Petri dishes and incubated in dark at room temperature. The water in the Petri dishes was changed every second day and the percentage of hatching success was assessed.

Characteristics of the composts

After 45 days, worms were removed from the WC composts. Samples of WC and WU composts were then sun dried and analysed for pH (1:2.5 soil water suspension), electrical conductivity (EC) (1:2.5 soil water suspension filtrate), organic carbon (OC) (Walkley and Black, 1934), nitrogen (N) (Humphries, 1956), phosphorous (P) (Jackson, 1973), potassium (K) (Toth and Prince, 1949), together with iron (Fe), magnesium (Mg), zinc (Zn) and copper (Cu) (Lindsay and Norvell, 1978).

Growth of the plants

For the assessment of the quality of the final composts as soil amendment, the different replicates of sun dried WC and WU composts were pooled together. Then 50, 75 and 100 g of compost were taken in plastic cups (200 mm height, 100 mm width) and mixed with 500 g of air dried soil (3 days) sieved below <2 mm. This corresponded to concentration values of 20, 30 and 40% of compost. Non amended soil was used as control. The soil characteristics were pH=7.3, 7.8% clay, 25% silt, 62.1% sand and 0.25% organic matter. The treatments were replicated three times. Two seeds of *V. radiata* were placed per plastic cup containing compost-soil mixture and irrigated regularly. After 20 days, plants were carefully uprooted and length and weight of the shoot and roots was measured.

Statistical analysis

One-way ANOVA followed by Tukey test at the 0.05 confidence level was performed to evaluate the significance of the observed differences in the earthworms growth, the number of cocoons produced per worm, the percentage of hatching and compost characteristics. Two-way ANOVA was performed on the worm-growth data using time and treatment as the independent factors. Finally, one-way ANOVA was employed to compare the effects of the different amendments effects within the worm-worked compost and worm-unworked compost on biometrics parameters of *V. radiate*.

RESULTS

Worms growth and reproduction

The worms in the control (WC-C) treatment grew well and attained a mean body mass of 747.9 mg (164%) in 45 days (Fig. 1). Further increase in the quantity of parthenium caused significant reduction ($p<0.05$) in growth rate (WC-P1, WC-P2 and WC-P3) and also mortality of earthworm (WC-P3) (<10%). However, there was no significant difference between the control (WC-C) and the neem treatments (WC-N1, WC-N2 and WC-N3). The statistical analysis employing two-way ANOVA showed a significant difference ($p<0.05$) in the growth rate of worms between control and parthenium plant and neem leaf treatments.

The worms in control treatment (WC-C) produced 12 cocoons per worm (Table 1). The decrease in number of cocoons produced per worm, compared to the control, was statistically significant at parthenium amendments of 100 g (WC-P3). The number of cocoons produced in neem leaf amended growth media remained the same as that of the control (>8). The total hatching success of cocoons in the control (WC-C) as well as in other treatments (parthenium and neem) was around 88%. The decrease in the percentage of hatching, compared to that of the control (85.8%), was statistically significant at parthenium amendment quantity of 75 g (WC-P2) and 100g (WC-P3). There was no significant difference in hatching of cocoons between controls and that observed in neem leaf treatments (Fig. 1 and Fig. 2).

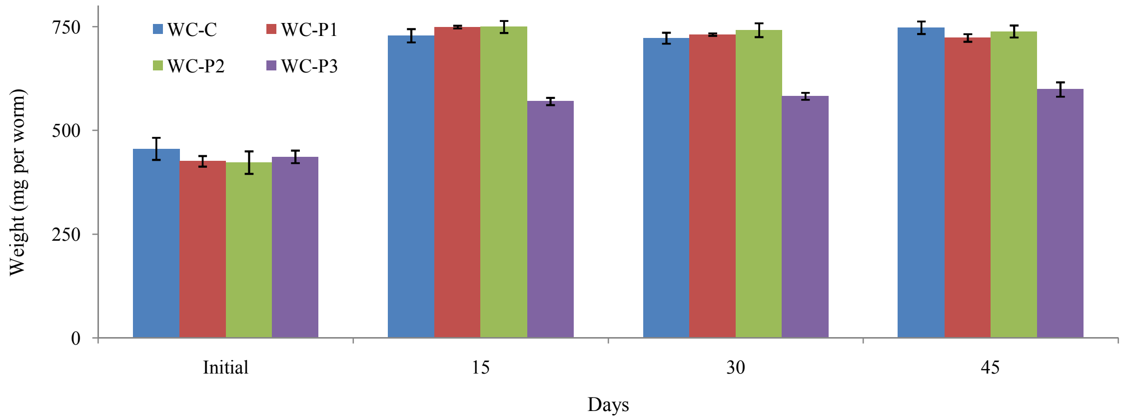

Fig. 1. Changes in the biomass of E. fetida (mg per worm) after 15 days their introduction in toughs amended with different concentration of parthenium plant.

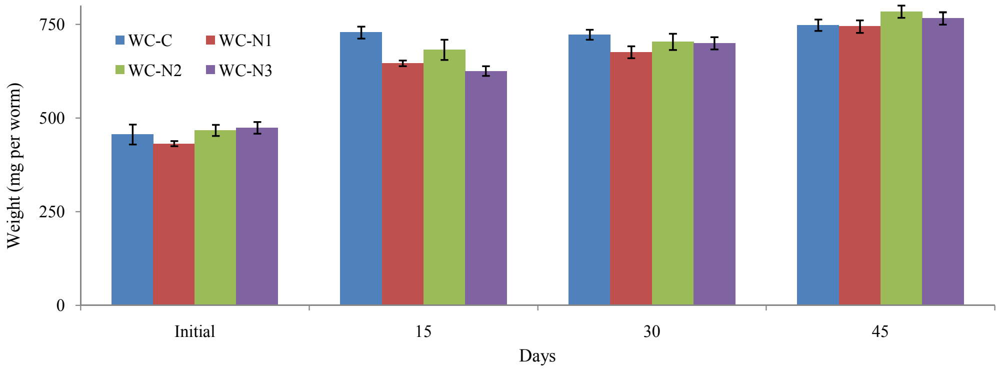

Fig. 2. Changes in the biomass of E. fetida (mg per worm) after 15 days their introduction in toughs amended with different concentration of neem leaves.

Table 1: Reproduction of the earthworm, *E. fetida* exposed to different treatments of parthenium plant and neem leaves (after 45 days)

Treatments	Treatment ID	Total number of eggs (n=30)	Number of eggs per worm	Number of eggs hatched	Per cent hatched
Cow dung	WC-C	360	12 ± 2.6	259	85.8
Parthenium plant	WC-P1	300	10 ± 4.0 ns	256	85.3 ns
	WC-P2	270	9 ± 3.0 ns	209	77.4 **
	WC-P3	108	4 ± 0.6 *	91	84.3 *
Cow dung	WC-C	360	12 ± 2.6	259	85.8
Neem leaves	WC-N1	251	8 ± 3.5 ns	219	87.3 ns
	WC-N2	338	11 ± 2.5 ns	284	84.0 ns
	WC-N3	299	10 ± 2.0 ns	243	81.3 ns

* $P < 0.05$ ** $P < 0.01$ ns - not significant

Characteristics of compost

Table 2 and 3 shows the chemical characteristics of the worm-worked and worm-unworked composts. Both composts recorded a significantly higher EC values except the worm-unworked compost WU-P1. Neutral to slight alkaline (6.8 to 8.5) range of pH values was found in all samples. There was no significant difference in the N and P content between the control and parthenium plant and neem leaves compost produced with worms and without worms (Tables 2 and 3). All treatments (worm-worked and worm-unworked parthenium and neem compost) produced significantly higher K contents than the control (p<0.05, Tables 2 and 3). Copper and zinc contents were significantly less in worm-worked parthenium and neem composts than in control (Table 2). In the case of parthenium worm-unworked compost, treatments were un-decomposed and the samples not enough for the analysis of micronutrient contents. Compared to control (WU-C), Cu and Zn contents were less neither with-significantly (Cu) nor without-significantly (Zn) in neem leaf worm-unworked compost (Table 3). Also, in general, there was no significant difference in Mg and Fe contents between the control (WC-U) and parthenium and neem leaves worm-worked composts. The Mg content of neem leaf compost produced without worm were significantly lower than the control compost whereas, Fe content was significantly high .

Table 2: Physiochemical characteristics of worm worked parthenium plant and neem leaves compost

Treatments		Composts with worms										
		pH	EC (mS cm^{-1})	Macronutrients (%)			Micronutrients (%)				Organic Carbon (%)	C/N ratio
				N	P	K	Cu	Zn	Mg	Fe		
Parthenium plant	WC-C	8.1±0.3	11.3±0.3	1.7±0.5	1.3±0.5	0.8±0.2	1.4±0.2	2.9±0.3	28.3±3.2	1.3±0.3	30.0±0.1	16.3±0.4
	WC-P1	8.2±0.2 ns	16.5±0.2 *	1.8±0.3 ns	0.8±0.2 ns	12.7±2.5 *	0.4±0.3 *	0.05±0.1 *	20.3±2.5 *	1.8±0.3 ns	30.1±01 ns	16.7±0.7 ns
	WC-P2	7.6±0.6 ns	21.5±1.5 *	1.8±0.2 ns	0.8±0.2 ns	15.5±1.3 *	0.3±0.1 *	0.07±0.1 *	30.4±2.4 ns	1.7±0.4 ns	31.5±1.1 ns	17.7± 0.1 ns
	WC-P3	8.1±0.3 ns	19.9±1.2 *	1.7±0.2 ns	0.7±0.2 ns	12.3±0.3 *	0.3±0.1 *	0.05±0.1 *	25.5±2.6 ns	1.5±0.4 ns	37.0±1.0 *	21.7±1.4 *
Neem leaves	WC-C	8.1±0.3	11.3±0.3	1.7±0.5	1.3±0.5	0.8±0.2	1.4±0.2	2.9±0.3	28.3±3.2	1.3±0.3	30.0±0.1	16.3±0.4
	WC-N1	6.8±0.3 *	21.3±1.3 *	1.1±0.4 ns	1.1±0.3 ns	15.5±1.3 *	0.3±0.1 *	1.1±0.1 *	22.4 ±2.6 ns	1.8 ±0.3 ns	30.6±0.3 ns	15.5±1.3 ns
	WC-N2	7.7±0.5 ns	25.1±1.2 *	1.5±0.4 ns	1.1±0.4 ns	11.5±3.4 *	0.3±0.1 *	1.1±0.1 *	21.9±9.5 ns	1.9±0.3 ns	28.9±1.5 ns	16.3 ±1.5 ns
	WC-N3	7.9±0.5 ns	22.1±1.3 *	1.1± 0.3 ns	1.6±0.2 ns	14.1±2.9 *	0.3±0.1 *	2.1±0.4 *	25.6±2.6 ns	1.7±0.3 ns	28.2±1.6 ns	15.7±1.3 ns

* $P < 0.05$ ns -not significant

Table 3: Physiochemical characteristics of worm un-worked parthenium plant and neem leaves compost

Treatments		Composts without worms										
		pH	EC (mS cm^{-1})	Macronutrients (%)			Micronutrients (%)				Organic Carbon (%)	C/N ratio
				N	P	K	Cu	Zn	Mg	Fe		
Parthenium plant	WU-C	7.1±0.4	10.6±0.4	1.6 ±0.3	0.8±0.3	0.5±0.2	1.3±0.3	0.1±0.03	18.2±0.7	0.4±0.0	52.3±2.1	32.3±1.5
	WU-P1	8.3±0.4 *	11.0±0.5 ^{ns}	1.7 ±0.2 ^{ns}	0.7±0.1 ^{ns}	8.7±2.1*	NA	NA	NA	NA	55.3±2.5 ^{ns}	32.0±1.0 ^{ns}
	WU-P2	8.4±0.3 *	15.3±0.3 *	1.5±0.1 ^{ns}	0.7±0.2 ^{ns}	8.3±1.5 *	NA	NA	NA	NA	55.7±3.5 ^{ns}	37.3 ±1.9*
	WU-P3	8.5±0.2 *	19.2±0.6 *	1.6±0.2 ^{ns}	1.0±0.4 ^{ns}	7.3 ±1.5*	NA	NA	NA	NA	56.0±3.0 ^{ns}	37.4±0.9 *
Neem leaves	WU-C	7.1±0.4	10.6±0.4	1.6 ±0.3	0.8±0.3	0.5±0.2	1.3±0.3	0.1±0.03	18.2±0.7	0.4±0.0	52.3±2.1	32.3±1.5
	WU-N1	7.7±0.8 ^{ns}	23.2±1.3 *	1.7±0.1 ^{ns}	0.8 ±0.2 ^{ns}	5.7 ±2.1*	0.1 ±0.1*	0.05±0.03 ^{ns}	13.9 ±1.2*	0.8 ±0.1*	58.3 ±1.5*	34.6 ±1.6 ^{ns}
	WU-N1	7.7±0.1 ^{ns}	20.3±1.9 *	1.7±0.1 ^{ns}	0.8 ±0.2 ^{ns}	9.3 ±2.5*	0.3 ±0.1*	0.07±0.03 ^{ns}	14.3±1.1*	0.8±0.1 *	56.7±2.1 *	34.8±3.0 ^{ns}
	WU-N1	7.7±0.2 ^{ns}	20.3±2.0 *	1.7±0.1 ^{ns}	0.8±0.1 ^{ns}	9.3± 1.2*	0.3±0.1 *	0.08±0.01 ^{ns}	13.6 ±0.8*	0.8 ±0.2*	56.7 ±1.5*	33.4±0.8 ^{ns}

* $P < 0.05$ ns - not significant NA – not analysed

When compared to control, significant difference of OC was found in compost only in the case of higher addition of parthenium plant compost obtained from worm-worked compost and all additions of neem leaves compost obtained from worm-unworked compost. Accordingly the carbon nitrogen ratios were also higher in composts produced without worms compared to those of produced with worms. Furthermore, carbon and carbon/nitrogen ratios of parthenium compost produced with worms were higher than those of produced from neem leaves.

Plant growth

The results for the biometric parameters of *V. radiata* after 20 days are presented in Tables 4 and 5. The germination rate of *V. radiata* was 100% in all the soil-composts mixtures and compost types. The shoot length of *V. radiata* in WC compost mixtures was significantly higher than that was observed in soil. Shoot length differences were not comprehensible in the case of WU composts however; higher addition rates of parthenium composts (WU-P2; 40% and WU-P3; 20, 30 and 40%) can reduce significantly on shoot length. The root length in neem leaves worm-worked compost amended soils was significantly higher than that observed in soil, where as the length of the root significantly decreased when plants grew in higher parthenium amendments (WU-P3; 20, 30 and 40%) obtained from worm-unworked compost. Further, as in the case of shoot length, root length was also higher in vermicompost than in compost produced without worms.

Generally, the plant wet and dry weights were greater in all worm-worked composts compared to those in soil. However, both of these parameters were significantly lower in all compost produced from worm-unworked compost than in soil. In general, between parthenium plant composts and neem leaves composts (from WC and WU) significant differences were not observed in any of the plant biometric parameters.

Table 4: Worm worked parthenium plants and neem leaves compost effect on biometric parameters of *V. radiata*

Treatment ID	Compost ratio (%)	Worm worked parthenium plant compost				Worm worked neem leaves compost			
		Shoot length (cm)	Root length (cm)	Wet weight (g)	Dry weight (g)	Shoot length (cm)	Root length (cm)	Wet weight (g)	Dry weight (g)
Soil		21.5±0.93	6.6±0.15	0.15±0.03	0.07±0.01	21.5±0.93	6.6±0.15	0.15±0.03	0.07±0.01
WC-C	20	27.8±0.49*	8.2±0.60*	0.16±0.02 ^{ns}	0.08±0.01 ^{ns}	27.8±0.49*	8.2±0.60 *	0.16±0.02 ^{ns}	0.08±0.01 ^{ns}
	30	28.0±0.95*	8.1±0.82*	0.14±0.02 ^{ns}	0.08±0.01 ^{ns}	28.0±0.95*	8.1±0.82 *	0.14±0.02 ^{ns}	0.08±0.01 ^{ns}
	40	28.4±0.47*	8.2±0.71*	0.14±0.01 ^{ns}	0.08±0.01 ^{ns}	28.4±0.47*	8.2±0.71 *	0.14±0.01 ^{ns}	0.08±0.01 ^{ns}
WC-P1	20	29.3±0.92*	7.7±0.51 ^{ns}	0.15±0.01 ^{ns}	0.08±0.01 ^{ns}	27.5±0.75*	8.8±0.61*	0.15±0.01 ^{ns}	0.09±0.01 ^{ns}
	30	29.2±0.90*	6.8±0.30 ^{ns}	0.16±0.01 ^{ns}	0.09±0.01 ^{ns}	29.3±1.00*	9.0±0.76*	0.17±0.03 ^{ns}	0.09±0.01 ^{ns}
	40	26.4±0.71*	7.2±0.15 ^{ns}	0.14±0.02 ^{ns}	0.09±0.01 ^{ns}	29.5±0.87*	8.9±0.82*	0.17±0.01 ^{ns}	0.09±0.01 ^{ns}
WC-P2	20	26.3±1.00*	6.6±0.56 ^{ns}	0.14±0.03 ^{ns}	0.09±0.01 ^{ns}	28.1±1.94*	8.9±0.95*	0.17±0.01 ^{ns}	0.09±0.01 ^{ns}
	30	29.6±1.15*	7.5±0.40 ^{ns}	0.13±0.02 ^{ns}	0.09±0.01 ^{ns}	28.3±0.83*	9.3±1.32*	0.18±0.02 ^{ns}	0.09±0.01 ^{ns}
	40	28.7±1.31*	6.5±0.21 ^{ns}	0.16±0.01 ^{ns}	0.09±0.01 ^{ns}	28.5±0.98*	9.7±0.85*	0.18±0.01 ^{ns}	0.08±0.02 ^{ns}
WC-P3	20	27.8±0.75*	6.1±0.85 ^{ns}	0.16±0.02 ^{ns}	0.09±0.01 ^{ns}	27.4±0.79*	9.3±1.02*	0.18±0.04 ^{ns}	0.08±0.01 ^{ns}
	30	26.7±1.21*	5.3±0.45 ^{ns}	0.15±0.03 ^{ns}	0.09±0.01 ^{ns}	27.5±0.75*	9.4±0.87*	0.17±0.01 ^{ns}	0.08±0.02 ^{ns}
	40	27.4±1.04*	5.8±0.62 ^{ns}	0.16±0.03 ^{ns}	0.09±0.01 ^{ns}	29.6±0.60*	9.0±0.45*	0.18±0.02 ^{ns}	0.09±0.01 ^{ns}

* $P < 0.05$; ns - not significant

Table 5: Worm un-worked parthenium plants and neem leaves compost effect on biometric parameters of *V. radiata*

Treatment ID	Compost ratio (%)	Worm un-worked parthenium plant compost				Worm un-worked neem leaves compost			
		Shoot length (cm)	Root length (cm)	Wet Weight (g)	Dry weight (g)	Shoot length (cm)	Root length (cm)	Wet Weight (g)	Dry weight (g)
Soil		21.5±0.93	6.6±0.15	0.15±0.03	0.07±0.01	21.5±0.93	6.6±0.15	0.15±0.03	0.07±0.01
WU-C	20	23.6±0.71 ^{ns}	6.6±0.55 ^{ns}	0.07±0.01 *	0.04±0.01 *	23.6±0.71 ^{ns}	6.6±0.55 ^{ns}	0.07±0.01 *	0.04±0.01 *
	30	22.6±1.09 ^{ns}	7.0±0.95 ^{ns}	0.07±0.01 *	0.04±0.01 *	22.6±1.09 ^{ns}	7.0±0.95 ^{ns}	0.07±0.01 *	0.04±0.01 *
	40	22.7±0.93 ^{ns}	7.1±1.00 ^{ns}	0.07±0.01 *	0.04±0.01 *	22.7±0.93 ^{ns}	7.1±1.00 ^{ns}	0.07±0.01 *	0.04±0.01 *
WU-P1	20	19.4±1.20 ^{ns}	6.1±0.70 ^{ns}	0.07±0.01 *	0.03±0.01 *	20.6±1.05 ^{ns}	5.5±0.70 ^{ns}	0.05±0.01 *	0.04±0.01 *
	30	19.5±0.95 ^{ns}	6.4±0.60 ^{ns}	0.07±0.01 *	0.03±0.01 *	20.7±0.47 ^{ns}	6.2±0.86 ^{ns}	0.11±0.03 *	0.03±0.01 *
	40	19.5±0.95 ^{ns}	6.3±0.56 ^{ns}	0.08±0.01 *	0.03±0.01 *	20.5±1.10 ^{ns}	6.3±0.60 ^{ns}	0.06±0.01 *	0.03±0.01 *
WU-P2	20	21.4±1.35 ^{ns}	6.8±0.35 ^{ns}	0.09±0.01 *	0.04±0.01 *	20.6±1.12 ^{ns}	6.3±0.78 ^{ns}	0.05±0.01 *	0.03±0.01 *
	30	20.5±1.10 ^{ns}	7.1±1.55 ^{ns}	0.09±0.01 *	0.03±0.01*	20.6±1.06 ^{ns}	6.3±0.65 ^{ns}	0.05±0.01 *	0.03±0.01 *
	40	12.6±1.06 *	6.4±1.12 ^{ns}	0.05±0.01 *	0.03±0.01 *	20.4±1.21 ^{ns}	6.2±0.85 ^{ns}	0.06±0.01 *	0.03±0.01 *
WU-P3	20	12.6±1.20 *	4.6±1.08 *	0.05±0.01 *	0.03±0.01 *	20.0±1.35 ^{ns}	6.4±0.71 ^{ns}	0.06±0.01 *	0.03±0.01 *
	30	12.7±1.03 *	4.8±1.11 *	0.05±0.01 *	0.03±0.01 *	20.5±1.31 ^{ns}	7.1±1.48 ^{ns}	0.06±0.01 *	0.03±0.01 *
	40	12.5±1.19 *	4.5±1.00 *	0.05±0.01 *	0.04±0.01 *	20.7±1.15 ^{ns}	7.1±1.16 ^{ns}	0.06±0.01 *	0.03±0.01 *

* $P < 0.05$; ns - not significant

DISCUSSION

Sustenance of efficient composting depends on growth, survival and perpetuation of earthworms. Unaffected growth without mortality and normal level of castings and their hatching success indicate acceptability of neem leaves as feeding material and its non toxic nature to earthworms irrespective of its pesticidel properties. Even though neem is known to kill nematodes rather easily, it had no deleterious effect on earthworms. On the other hand, significant reduction in the growth of worms in highest treatment of parthenium plant (WC-P3), the weight gain, and the number of castings laid showed parthenium is toxic to earthworm beyond 75 g (WC-P3) of parthenium amendment with 500 g of cow dung. These results are contradictory to the previous observations of Nagendra and Kavita (1999) wherein an increase was observed in the weight of *Amynthus alexandri* was observed within 60-70 days. This may probably be due to the addition of 2 kg of soil with parthenium and cow dung mixture.

The composts produced from both neem leaves and parthenium plants promoted the growth of *V. radiata* to a level comparable to that of the cow dung compost. Further, growth indices recorded for *V. radiata* were comparatively better (not significantly) in composts produced with worms than without worms suggesting the level of improvement of fertility and productivity of the soil by worm-worked composts even though the organic carbon content of composts produced with worms was less than that in composts produced without worms (Table 2 and 3). However, perusal of the data on micronutrient content of composts showed that their contents were comparatively higher in composts produced by the former than by the latter. Comparatively the higher level of organic content in non worm-worked composts may be due to the increase in their microbial load, which is expected to be less in worm-worked composts (Garg and Kaushik, 2005; Parvaresh *et al.,* 2004; Suthar, 2009). Moreover, significant reduction in the organic carbon in higher treatment of worm-worked parthenium plant and neem leaf composts may be related to its assimilation in the process of composting leading to their growth related weight gain.

The observed increase in the EC, N, P, K and micronutrients (Cu, Zn, Mg and Fe) in all worm-worked composts (except in the case of N in neem leaves compost) showed that the activity of earthworm *E. fetida* along with microorganisms promoted mineralization process and brought the nutrients to ready to use form for plant growth. Similar findings have been reported for *Amynthus alexandri* by Mba (1983) and Karmegam and Daniel (2000). The C/N ratio was low in worm-worked composts than in worm-unworked composts and this shows that *E. fetida* is a very good decomposer of both parthenium and neem leaves irrespective of their known antibiological properties and is capable of reducing C/N ratio very quickly. A similar reduction in C/N ratio was reported by Senapati *et al.,* (1980), Mba (1983), Talashilkar *et al.,* (1999), Bansal and Kapoor

(2000) and Karmegam and Daniel (2000).

Neem leaf contains a group of pharmacologically active compounds, the neem limonoids, which have well reached efficacy for antimicrobial properties. Application of the neem plant parts or extracts to nematode infested soil affects nematode directly and stimulates soil microbes that reduce nematode populations (Muhammad *et al.,* 2004). If the composts produced from neem leaves retained limonoids they may help to contain soil plant pathogens, an added advantage apart from the nutritive value of the composts. Parthenium is a weed and its allelopathic activity was attributed to parthenium (Khosla and Sobti, 1981). Efficiency of *E. fetida* in composting parthenium is a welcome sign, though growth reduction and egg laying efficiency was reduced, because composting of parthenium serves for a dual purpose of eradication of the weed as well as for a better utilization as compost. The study indicates that *E. fetida* can very well be used for the production of high quality vermicompost from the medicinal plant neem and common weed parthenium.

Among the two tested plant organic matter sources used for composting, parthenium reduced the growth and reproductive efficiency beyond the amendment concentration of 75 g 500 g^{-1} of cow dung. An increase was recorded in the EC, NPK and micronutrient (Cu, Zn, Mg and Fe) contents of composts. In addition, a reduction was recorded in the C/N ratio. This shows that *E. fetida* is a very good decomposer of parthenium plant and neem leaves. Parthenium composting at low amendments with cow dung may help its eradication for better utilization. Neem compost, if it retains Limonoids may help to contain soil plant pathogens.

ACKNOWLEDGEMENTS

The authors thank Dr. P. Lakshmanaperumalsamy, Professor and Head, Department of Environmental Sciences, Bharathair University for his keen interest in the present work.

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