4. Evaluation of the Nutrient Content of Vermicompost Prepared from Different Proportions of Lantana Camera and Other Organic Wastes at Efratanagdem District, Ethiopia

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Abstract

Lantana camara is a noxious weed which is widely distributed in eastern Amhara and disturbing the day to day life of the smallholder farmers. Wise utilization of this weed as organic waste or vermicomposting is an environmentally sound and economically feasible technology resulting in the production of alternative organic fertilizer source. Hence, the experiment was conducted at Efratanagidem district to determine the nutrients content of vermicompost prepared from different proportions of lantana camara and other organic wastes for two consecutive years (2017/18-2018/19). Lantana camara biomass and other organic wastes (Jatropha, Banana pseudo stem and weed from cultivated land) were mixed at different levels (w/w basis) to give five different ratios (0:100%; 25:75%; 50:50%; 75:25). The experiment was laid out in a completely randomized design with four replications. Plastic pots of 10 litre capacity were used for vermicompost production. Composting materials were chopped and mixed in different ratio for all treatments and allowed for about 30 days to partially decompose and create suitable condition for the composing worms. Then 200 red worms (Eisenia fetida) were introduced in to each treatment. The analysis of variance revealed that mixture of lantana camara with different feeding materials of produced vermicasthad a highly significant ($p<0.05$) influence on all tested parameters of vermicompost. The result indicates that the highest total Nitrogen (1.70%), organic carbon (17.79%), lowest carbon to Nitrogen ratio, (10.57) available Phosphorus (1083.87 ppm) and available Potassium and (1.91%) were recorded from the vermicompost prepared from a mixture of 75% lantana camara with other green wastes. Generally, it is possible to conclude and recommend that among the substrate used for the experiment the highest values of total Nitrogen and the highest values almost all tested parameters were recorded by higher proportion of lantana camara substrate. Therefore, lantana camara biomass alone or mixed with other green wastes is suitable for the production of quality vermicompost and recommended for farmers around Efratagedim district and similar agro-ecologies for vermicompost preparation and manage invasive weed in useable manner.

***Keywords**: Eisenia fetida, Green wastes, Lantana camara, organic waste, Vermicomposting*

Introduction

Lantana camara is one of the most commonly known noxious weed distributed worldwide (Rakesh *et al*., 2016). The red flower variety (*L. camara* var. aculeata) of this weed is mainly toxic and usually prevalent in tropical and sub-tropical countries (Pereira *et al*., 2003; Mello *et al*., 2005). Lantana affects grazing land and disturbs the ecology. It releases inhibiting chemicals in the soil to prevent other plants from germination (https://en.wikipedia.org/wiki/Lantana_camara). L.camara is good example on the impact of introduction and invasion on biodiversity of the Ethiopia (Rezene *et al*., 2012). It found in cultivated and non-cultivated lands of Ethiopia.

Extensive efforts have been made with billions of dollars invested, to control invasive weed species like lantana by physical, chemical or biological means (McFadyen, 1998; Day *et al.,* 2003; Zalucki*et al.,* 2007). However, these attempts have not succeeded in even controlling, let alone eradicating, any of the major weeds. Some research reports indicated that other controlling mechanize were appeared and developed for advantageously utilizing the invasive, it may not only offset the costs of mechanically removing them but also exercise some control over their spread. According to Tessema (2012) “Eradication by Utilization” is believed that economic exploitation of invasive species as a means of harnessing their economic potentials for meeting basic human needs and at the same time controls its spread and possibly eradicate them. In the form of biodegradation, a possible option is conversion of weeds into vermicompost and utilizing the latter as a soil fertilizer. Vermicomposting of a substrate is believed to convert some of its nutrients into more bioavailable forms and bestow upon the substrate micro flora that is beneficial for soil health (Gajalakshmi and Abbasi, 2008; Edward *et al.*, 2011).

Suthar and Singh, (2008) also reported that different weed or plant residues commonly available in any agricultural land can be converted to a potential plant-nutrient enriched resource - compost and vermicompost that can be utilized for sustainable land restoration practices. The biomass of lantana camara is huge that could be utilized by the farmers to prepare compost and vermicompost that could be utilized as an organic manure. Animal dung serves as a good source of inoculants in composting medium to increase the microbial population (Singh and Angira 2011). Proper utilization of Lantana biomass through appropriate technologies like composting and mulch etc. may help in supplementing chemical fertilizer besides adding organic matter to the soil. The macro nutrients were also found to be improved in all the vermicomposts. Laboratory analysis result of Lantana camara Nitrogen Phosphorus and Potassium content is 27, 1.6-2.4 and 21-27 Kgton^{-1} comparable to manure which is 7-23, 1-11 and 6-8 Kgton^{-1} (Tamene *et al*., 2017; Zingore *et al*., 2014 and Kaizzi and Wortmann 2001). Studies by Singh and Angiras (2011) have also reported that the macronutrients were improved by the decomposition of Lantana with animal manures and earthworms. Banta and Dev (2009) have also reported that the Nitrogen enriched Phosphorus compost prepared from Lantana was found to be beneficial for the improved yield and nutrient uptake in wheat.

The laboratory analysis result of vermicompost produced from Lantana camara revealed that the phenols and the sesquiterpene lactones that are responsible for the allelopathic impact of Lantana were largely destroyed in the course of vermicomposting and there is also an indication that lignin content of Lantana was reduced during its vermicomposting (Hussain *et al.,* 2015). In addition to this, to confirm the reduction of allelophatic effects of vermicomposted lanta materials used to see the germination index of seed bioassay test indicated beneficial and useful for the growth of agricultural crops (Sharma *et. al*., 2016). Such type research findings help to open up the possibility that the billions tons of biomass that is generated annually by Lantana can be gainfully utilized in producing organic fertilizer via vermicomposting.

Vermicomposting is a mesophilic process and is the process of ingestion, digestion, and absorption of organic wastes by earthworms followed by excretion of castings through their metabolic systems during which the biological activity of earthworms enhances plant-nutrients of organic waste (Venkatesh and Eevera, 2008). Vermicompost possesses higher and more soluble levels of major nutrients - Nitrogen, Phosphorus, Potassium and magnesium (Bansal and Kapoor, 2000; Singh and Sharma, 2002; Reddy and Okhura, 2004) compared to the soil, and the normal compost. During the process, the nutrients locked up in the original substrate organic waste are changed to simple and more readily available and absorbable forms such as nitrate or ammonium Nitrogen, exchangeable Phosphorus and soluble Potassium, calcium, magnesium in the worm's gut (Lee, 1985 and Atiyeh *et al***.,** 2002).

Among the 8000 known species of earthworm only seven are suitable for use in composting, all belonging to the epigeic category. Throughout the world the most commonly employed species is the Tiger Worm, sometimes referred to as the Red Wiggler or Californian Red (*Eisenia fetida*). Native to Europe the Tiger Worm has exceptional adaptability and tolerance to a range of food sources, temperature variation (12-35°) and moisture content (60-90%). This species also has the capacity to double its population every 60 days and consumed up to half their body weight a day, particularly suitable for the application in the management of organic waste. Therefore, this research aimed at technology development and evaluation of the nutrient contents of vermicompost prepared from the different combination of lantana camara and other organic wastes for the production of quality vermicompost from locally available organic waste materials using composting earthworm.

Materials and Methods

Description of Study Area: The experiment was carried out at farmers training centre (FTC) Ferede weha kebele Efratanagedem district, North Shewa Zone, Eastern Ethiopia for two consecutive years (2018/19-2019/20). Geographically, the experimental sites were located at 10°17'20" to 10° 24‘ 22" N and 39°54‘ 26" to 39° 55‘ 23“ with the altitude ranges of 1488-1586 m.a.s.l. Long term climate of the study areas are characterized by a unimodal rainfall pattern and receive an average annual rainfall of 762.5mm. The long term annual mean minimum and maximum air temperatures were 14.61 and 30.01 respectively.

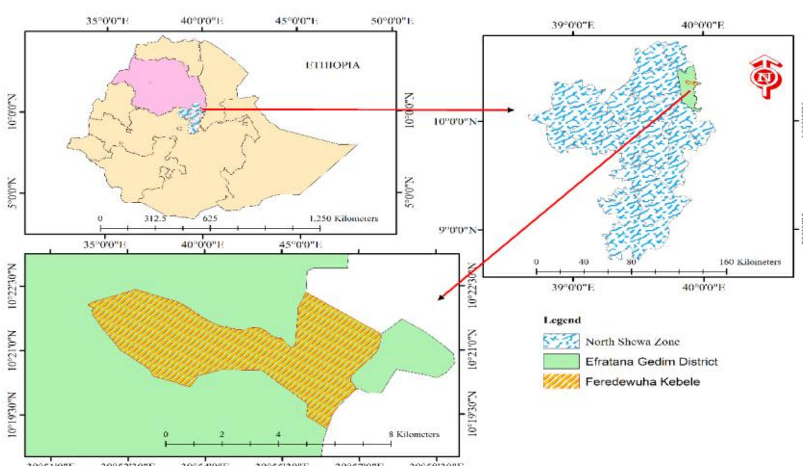

Figure 1. Map of the study area

Treatments and Experimental Design: The experiment was conducted in a shaded area. The Lantana camera weed biomass was collected from the roadside and hillsides of nearby farmlands and then chopped to a smaller size. In order to create a representative sample, manure was gathered from nearby households and mixed in. Lantana camara biomass and other agricultural green wastes (jatropha and weed from cultivated land) were mixed at different levels (w/w basis) to give five different combinations. The mixtures were left with moisture for 21 days in order to semi compost the feed to become more palatable and softer for the worms. Eisenia foetida was used for vermicomposting by introducing equal number/weight on different treatment combination. The moisture and temperature was maintained by sprinkling water and turning the mixture.

The experiment was laid in a completely randomized design replicated four replicates. These different ratio combinations were then evaluated for different physical properties, pH and C/N ratio of vermicompost and major nutrients NPK analyzed. This process was repeated at least 3 to 4 times to see the performance of earth worm's vermicomposting capacity at different seasonal condition. The details of the treatments are shown in here

1. 0:100% Lantana camara (0 Kg) + other organic wastes (5 Kg)
2. 25:75% Lantana camara (1.75 Kg) + other organic wastes (3.25 Kg)
3. 50:50% Lantana camara (2.5 Kg) + other organic wastes (2.5Kg)
4. 75:25% Lantana camara (3.25 Kg) + other organic wastes (1.75Kg)
5. 100:0% Lantana camara (5 Kg) + other organic wastes (0 Kg)

To carry out the experiment under shade and create uniform climate condition for vermicomposting process, Site was selected with collaboration of Efrata gedim district Agricultural office experts. The organic waste (manure) was collected from local house hold and goat ranch mixed together to get representative sample. Lantana camera twigs and leaves of regenerated after cutting were collected from hillsides of closed areas, and road sides of the farm lands and chopped in to pieces. In addition, other green organic materials like pseudo stem and its leafy parts of banana, Jatropha carcass and weed biomass were collected and chopped. Furthermore, weed material were also collected from farm lands, mostly grassy type locally called *ingicha dominated.* Pots of a size of about 10 litre capacity were prepared for Vermicompost preparation. Then the pots were filled with different ratios of lantana camara and other organic wastes. Composting materials were chopped and mixed with liquid manure as slinking purpose with a 1:1 manure water ratio for all treatments in equal amount and allowed for about 30 days to partially decomposed to create suitable condition for composing worms and substrate become more palatable. All pots were placed on raised bed made from wooden materials to protect earthworms from their enemies like ant and termites. In addition, liquid soap foam and kerosene were sprayed under the shade to prevent the aforementioned pests. After 30 days, the earthworm (n=200) (Eisenia foetida) was inoculated to each treatment for vermicomposting. The moisture and temperature were maintained by sprinkling water on fiber bag used as cover a pot and under shade and above pots there was plastic shade to protect an unexpected rain occurrence. Proper aeration in the vermicomposting unit was maintained by regular turning using wooden pigs that were already prepared for each composting pots. After vermicomposting, the number of earthworms in the finished vermicompost from each pot was counted by hand sorting and vermicompost yield was measured using weighing balance. The produced vermicomposts from different feeding materials were then packed in bags, labelled, transported to Debrebirhan Agricultural Research Center's soil laboratory and air dried at room temperature.

Chemical Analyses: The homogenized sub-samples of each substrate material and their respective vermicompost samples (on the basis dry weight) were collected destructively at 0 (i.e., from each plot and which were processed for analyses of organic carbon (OC) and total Nitrogen (TN), available Phosphorus (P), and exchangeable Potassium. The pH, and electrical conductivity (EC) were recorded for the vermicomposting. The pH and EC of samples were recorded by a digital pH meter and conductivity meter, respectively (Reeuwijk V, LP, 1993). The OC of the samples was measured by Walkey-Black method (Walkley and Black, 1934). The TN was estimated by the Kjeldahl method (Jackson, 1968), and the P and K contents of the samples were analysed by spctrophpotometer (Oleson, *et al.*, 1954) and flame photometric method (Jackson, 1958), respectively. The ratio was calculated from the measured values of C and N. Total vermicompost productivity (VP %) was determined from the total harvested vermicompost divide by initial vermicompost in Kg used and multiplied by 100 (Goswami and Kalita, 2000).

$$\text{VP\%} = \frac{\textbf{Total harvested vermicompost amount (Kg)}}{\textbf{Total weight of organic substrate used (Kg)}} \times 100$$

Data Analysis: Statistical Analysis. One-way analysis of variance (ANOVA) was computed using SAS software (version No. 9.1) to test the level of significance of difference between the vermicomposts produced by the three combinations of substrate with lantana camara and vermicompost samples with respect to nutrient parameters.

Results and Discussion

Some Chemical Characteristics of Initial Raw Materials: Table 1 lists the chemical properties of manure, weed biomass, bananas, Jatropha carcasses, and lantana camara used as raw materials for vermicomposting. The raw materials had the following total organic carbon (TOC) contents: manure (31.17%), weed biomass (26.96%), banana (23.35%), Jatropha carcass (28.74%), and lantana camara (29.350%). Comparably, the lantana camara had a total Nitrogen (TN) content of 2.02%, bananas 0.49%, Jatropha carcasses 1.89%, weed biomass 1.36%, and manure 1.60%, indicating variations in the initial substrate used (Table 1). Table 1. Some chemical characteristics of Initial raw materials

Table 1. chemical properties of raw materials

Parameter	Lantana camara	Banana	Jatropha carcass	Weed biomass	Manure
P (ppm)	13.25	6.89	12.72	10.07	685.67
K (%)	2.23	-	1.08	-	0.94
OC (%)	29.35	23.35	28.74	26.96	31.17
TN (%)	2.05	0.49	1.89	1.36	1.60
C:N	9.62	47.65	15.21	19.82	20.56

pH and EC of Vermicompost: A significant difference ($P<0.05$) was observed among treatments in pH and electrical conductivity (Table 2). The pH is important parameters for the evaluation of vermicompost maturity and quality. The decomposition of organic matter into organic acids causes a pH decrease as the lantana ratio increases. Vermicomposts with a pH range of 6–8.5 are ideal for applying soil fertilizer sources (Hogg *et al*., 2002). Plants have a maximum EC tolerance limit of 4.0 dS/m. Hence, manure with EC below this value can be applied to soil for plant growth and development (Lasaridi *et al*., 2006). The EC that was obtained from lantana vermicompost was higher than that of other lower and sole proportions. This could have been caused by the initial substrate material releasing more mineral ions during the vermicomposting process, such as phosphate, ammonium, and Potassium (Suthar, 2007). Table 2 shows pH (H_2O 1:2.5) and EC (dS/m) of vermicompost made from different mixture of lantana camara with other green waste (Banana pseudo stem, Jatropha carcass and weeds)

pH and EC of vermicompost made from different mixture of lantana camara with other green waste

Lantana ratio	Lantana:Banana		Lantana:Jatropha		Lantana:Weed		Mean	
	pH	EC	pH	EC	pH	EC	pH	EC
0:100	8.34^{b}	2.34^{c}	8.39^{b}	1.43^{d}	8.64^{ab}	2.78^{c}	8.46^{b}	2.18^{c}
25:75	8.63^{a}	1.52^{d}	8.29^{b}	1.91^{c}	8.69^{ab}	2.88^{c}	8.54^{ab}	2.10^{c}
50:50	8.55^{a}	2.85^{b}	8.66^{a}	2.39^{b}	8.77^{b}	3.23^{bc}	8.66^{a}	2.82^{b}
75:25	8.35^{b}	2.54^{c}	7.95^{c}	2.92^{a}	8.66^{ab}	3.74^{ab}	8.32^{c}	3.07^{b}
100:0	8.00^{c}	3.91^{a}	7.94^{c}	2.70^{ab}	8.54^{b}	4.01^{a}	8.16^{c}	3.54^{a}
CV (%)	1.43	11.12	2.34	15.28	1.84	18.27	2.60	19.57
LSD (5%)	0.12	0.30	0.20	0.35	0.16	0.62	0.13	0.31
Substrate Mix type	pH	EC						
Lantana: Banana	8.37^{b}	2.63^{b}						
Lantana: Jatropha	8.24^{c}	2.27^{c}						
Lantana: Weed	8.66^{a}	3.33^{a}						

Available Phosphorus: The analysis of variance indicated that the available Phosphorus was highly significantly ($p < 0.05$) influenced by the treatments (Table 4). The highest (1083.87 ppm) mean available Phosphorus content was registered by feeding of 75% of lantana camara with 25% other feed socks. While the lowest (954.57 ppm) mean available P was recorded by feeding of 100% of other green wastes. This result is in line with the finding of Zarei *et al*., (2011) whom reported that available Phosphorus in vermicompost ranges 1056-1643 $mgKg^{-1}$ respectively.

According to Pramanik *et al.*, (2007), maximum Phosphorus in the final feed stocks of vermicompost is mainly due to acid formation during organic waste decomposition is responsible for solubilisation of insoluble Phosphorus. The net loss of dry mass which concentrates the Phosphorus in the final feed stocks of vermicomposting also increases the Phosphorus content (Ravindran and Sekaran 2010).

Table 3. Av. Phosphorus (ppm) of vermicompost made from different mixtures of lantana camara with other green waste (banana pseudo stem and weeds)

Treatment	Lantana:Banana	Lantana:Jatropha	Lantana:Weed	Mean
0%:100%	1025.60[a]	1048.64[b]	789.45[b]	954.57[b]
25%:75%	1147.51[b]	1069.82[b]	798.05[b]	1005.13[b]
50%:50%	1071.03[b]	1049.41[b]	789.76[b]	970.06[b]
75%:25%	1062.16[b]	1051.69[b]	1137.76[a]	1083.87[a]
100%:0%	1056.73[b]	1225.66[a]	781.07[b]	1021.15[ab]
CV (%)				13.65
LSD (5%)				78.55

Substrate Mix type	Mean (n=120)
Lantana: Banana	1072.60[a]
Lantana: Jatropha	1089.04[a]
Lantana: Weed	859.22[b]

Exchangeable Potassium and CEC: The analysis results of of variance showed that treatments had a highly significant ($p < 0.05$) effect on exchangeable bases K^+ (Table 5). Table 5 shows that the mixture of 75% lantana and 25% banana substrate had the highest exchangeable Potassium (2.61%). Additionally, cation exchange capacity was significantly affected by treatments ($p < 0.05$). A mixture of lantana and Jatropha produced the lowest CEC (52.84 meq/100 gm), while lantana camara mixed with banana produced the highest CEC (56.66 meq/100 gm) (Table 5). This result is consistent with Tadele *et al.*, (2018)'s finding that the CEC in vermicompost varies from 57 to 68.70 mg/Kg.

Table 4. Ex. K (%) and CEC (meq/100 gm) of vermicompost made from different mixture of lantana camara with other green waste (banana pseudo stem and weeds)

	Lantana:Banana		Lantana:Jatropha		Lantana:Weed		Mean	
Treatment	Ex. K (%)	CEC	Ex. K (%)	CEC	. Ex. K (%)	CEC	Ex. K (%)	CEC
0:100%	2.17[c]	54.36[b]	0.94[c]	53.91[a]	1.46[b]	55.35[b]	1.52[c]	54.54[b]
25:75%	2.46[b]	59.99[a]	1.09[ab]	53.65[a]	1.85[a]	59.68[a]	1.80[ab]	57.77[a]
50:50%	2.42[b]	53.64[b]	1.04[bc]	51.26[b]	1.77[a]	50.95[c]	1.74[ab]	51.95[c]
75:25%	2.61[a]	55.03[b]	1.22[a]	50.55[b]	1.84[a]	55.07[b]	1.91[a]	53.55[b]
100:0%	2.36[b]	58.80[a]	0.97[bc]	54.83[a]	1.60[b]	56.98[ab]	1.64[bc]	56.87[a]
CV (%)	4.37	3.74	13.08	3.33	9.12	4.78	16.38	5.04
LSD (5%)	0.11	2.15	0.14	1.80	0.16	2.71	0.16	2.64

Substrate Mix type	Ex. K (%)	CEC
Lantana: Banana	2.41[a]	56.66[a]
Lantana: Jatropha	1.00[c]	52.84[b]
Lantana: Weed	1.71[b]	55.61[a]

Organic carbon, Total Nitrogen and Carbon to Nitrogen ratio: The analysis of variance indicated that mean organic carbon content was highly significantly ($p < 0.05$) influenced by the treatments. The highest OC (17.79%) was registered by 100% lantana camara substrate, while the lowest (16.00%) was recorded by 100% or sole lantana, Jatropha and weed feeding ratio (Table 6). Over the course of the vermicomposting and composting processes, organic carbon decreased for all of the substrates used. When compared to its initial value, the organic carbon (OC) in the full dose of lanata camara significantly decreased. During vermicomposting, Elvira *et al*., (1998) and Kaushik and Garg (2003) have reported losing 20–45% of the organic carbon (OC) in the form of CO_2 from various organic substrates. The analysis of variance indicated that total Nitrogen (TN) was highly significantly ($p < 0.05$) influenced by the substrate mix tpye and ratio of lanatana camara. As compared to other mixes, the highest total Nitrogen content was obtained from sole lantana camara (1.90%) followed by 75%:25% lantana:Jatropha (1.73%) and 50%:50% lantana:jatropha (1.71%) while the lowest TN wasobtained from 100% weed (0.83%) (Table 6). Research result indicated that, total Nitrogen content in vermicomposts can range quite widely from 0.1% to 4% or more (Ibrahim *et al*., 2013). In genera, lanatana camara and jatropha carcas substrate mixture showed highest mean Nitrogen (1.72%) content compared from banana pseudo stem and weed biomass (Table 6). This might be due to the high nitrification rate in which ammonium ions are converted into nitrates (Dominguez, 2004). The Nitrogen content of vermicomposts produced varies from substrate to substrates and hence the standard total Nitrogen content of compost ranges from 1.5-3.5 % (Katheem Kiyasudeen *et al*., 2016). Study report also indicated thate compost fertilizing capacity and used as source orgnic fertilizer that total Nitrogen content must be over 1% (Kefyalew and Tilahun, 2018).

The mean C/N ratios of vermicomposts of three substrates ranges from 10.1:1-16.37:1; such ratios make nutrients easily available to the plants (Table 6). Plants cannot assimilate mineral N unless the C/N ratio is about equal or less than 20:1, and this ratio is also an indicative of acceptable maturity of compost (Morais andand Queda, 2003). In the present study, all organic substrate mixed with lantana camara in different proportion had a C:N ratio below 20 which indicated the higher N mineralization upon their incorporation in the soil. The C/N ratio of the substrate material reflects the mineralization and stabilization of the organic wastes during the process of composting or vermicomposting. The carbon/Nitrogen ratio decreases due to the rapid decomposition of organic waste, as well as mineralization and stabilization during the vermicomposting process. According to Senesi (1989), a decrease in C:N to less than 20 indicates an advanced degree of maturity in organic waste.

Table 5. Mean OC (%),TN (%) and C: N of vermicompost made from different mixture of lantana camara with other green waste (banana pseudo stem, jatropha carcass and weeds)

Treatment	Lantana:Banana			Lantana:Jatropha			Lantana:Weed			Mean		
	OC	TN	C:N	OC	TN	C:N	OC	TN	C:N	OC	TN	C:N
0%:100%	14.15^{b}	0.87^{b}	16.55^{a}	17.48^{b}	1.59^{c}	10.98^{a}	16.34^{c}	0.83^{c}	20.22^{a}	16.00^{b}	1.10^{d}	15.92^{a}
25%:75%	15.28^{a}	0.87^{b}	18.34^{a}	16.85^{c}	1.65^{bc}	10.15^{b}	17.53^{b}	1.38^{b}	12.89^{bc}	16.55^{ab}	1.30^{c}	13.79^{b}
50%:50%	15.74^{a}	0.91^{b}	17.72^{a}	17.47^{b}	1.71^{b}	10.12^{b}	17.37^{bc}	1.31^{b}	13.30^{b}	16.86^{ab}	1.31^{bc}	13.71^{b}
75%:25%	15.47^{a}	0.91^{b}	17.60^{a}	17.01^{bc}	1.73^{b}	9.76^{bc}	18.95^{a}	1.65^{a}	11.91^{bc}	17.14^{ab}	1.42^{b}	13.09^{b}
100%:0%	16.02^{a}	1.40^{a}	11.62^{b}	18.17^{a}	1.90^{a}	9.48^{c}	19.19^{a}	1.81^{a}	10.61^{c}	17.79^{a}	1.70^{a}	10.57^{c}
CV (%)	5.09	10.55	11.92	2.84	6.35	5.94	6.10	13.92	16.33	17.49	16.50	20.42
LSD (5%)	0.80	0.11	1.99	0.50	0.11	0.61	1.11	0.20	2.30	1.69	0.13	1.57

Substrate Mix	OC (%)	TN (%)	C:N
Lantana: Banana	15.33^{b}	0.99^{c}	16.37^{a}
Lantana:Jatropha	17.39^{a}	1.72^{a}	10.10^{c}
Lantana: Weed	17.88^{a}	1.39^{b}	13.79^{b}

Number of Alive Worms: Table 3 shows that the vermicompost made from 100% lantana camara substrate had the highest mean earthworm number (215) among the three combinations, while the lowest number of worm population (151) was found in the vermicompost made from 50% lantana camara substrate along with other green vermicompost, which was also lower from lantana camara alone. This could be because the mixture included leaf biomass, which encouraged earthworm growth. In a related study, using tree leaves as the only food source resulted in a greater increase in the E. foetida population than using cow dung alone (Nagavallemma *et al*., 2004).

Table 6. Mean number of alive earthworms

Lantana ratio	Lantana:Banana	Lantana:Jatropha	Lantana:Weed	Mean
0:100	189[c]	64[c]	244[b]	165[bc]
25:75	215[bc]	76[b]	211[c]	167[bc]
50:50	218[b]	54[c]	182[c]	151[c]
75:25	207[bc]	60[c]	253[b]	173[b]
100:0	248[a]	105[a]	292[a]	215[a]
CV (%)	12.32	13.02	9.80	17.72
LSD (5%)	27.04	9.54	23.59	17.68

Substrate Mix type	Number of worms
Lantana: Banana	215[b]
Lantana: Jatropha	72[c]
Lantana: Weed	236[a]

Table 7: Amount of vermicast (Kg) produced from different mixtures of lantana camara and other organic wastes

Treatment	Lantana:Banana	Lantana:Jatropha	Lantana:Weed	VC productivity %
0%:100%	1.17^{c}	1.17^{c}	1.66^{ab}	33.28^{c}
25%:75%	1.29^{bc}	1.33^{bc}	1.61^{b}	35.31^{bc}
50%:50%	1.31^{b}	1.44^{ab}	1.77^{ab}	37.66^{b}
75%:25%	1.71^{a}	1.50^{a}	1.84^{ab}	42.05^{a}
100%:0%	1.79^{a}	1.47^{ab}	1.88^{a}	42.86^{a}
CV (%)	8.55	11.98	13.80	17.45
LSD (5%)	0.13	0.17	0.25	3.82
Substrate Mix type		Mean	VP%	
Lantana: Banana		1.45^{b}	36.36^{b}	
Lantana: Jatropha		1.38^{b}	34.35^{b}	
Lantana: Weed		1.75^{a}	43.79^{a}	

Conclusion and Recommendation

The research reveals that lantana camara mixtures with different ratios of other organic wastes differ in their nutrient composition and the amount of nutrient released from their combinations. Based on the amount of nutrients released from the combinations, the sole or 50%:50% combination of lanatan camara with jatropha provided more total Nitrogen and was suitable for vermicomposting by earth worms. As a result, vermicompost production from Latana camara using effective vermicompost worms should be verified and demonstrated on farmers' fields in order to eradicate this noxious weed from all land use types through utilization.

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