ISSN: 2278-778X
Research Article
www.ijbio.com

COMPARATIVE STUDY OF VERMICOMPOST USING *PARTHENIUM BIODUNG* AND USUAL GREEN BIODUNG

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Received for publication: November 19, 2012; **Accepted**: January 09, 2013.

Abstract: *Parthenium hysterophorus* has achieved major weed status in India and Australia within past few decades, and within last decade it has become one of the seven most dreaded weeds of the world. The weed reduces the dry matter of crops, sucks the nutrients and starves the crops. Thus considering the great importance of the problem, health hazards, nuisance value, resistive seeds, toxicity of parthenin, and quiet amount of nutrients inside the plant and its easy availability in large quantity, this green Parthenium weed is selected as a special bio-mass in this experiment aimed to degrade the whole plant including seeds biologically to prepare compost and thus recycling organic matter of the weed back to the soil to replenish it and at the same time reducing its toxicity through hot or aerobic composting. Present work was focused on biodegradation of Parthenium bio-mass safely so that the manure does not contain the seeds of Parthenium. Thus considering its easy availability in huge quantity, its immense nutritive potential, its hazardous effects on human being, its nuisance to the agricultural field, its large number of pollens causing pollution of air and allergenic diseases, this obnoxious weed was selected as special organic bio-mass for the preparation of compost. This experiment will prove a great asset to the farmers to use it with other green bio-mass for the preparation of compost without any doubt.

Keywords: Compost, Anaerobic, Parthenium

INTRODUCTION

The principle of sustainable development requires that materials no longer used are either recycled or biologically degraded. In modern agricultural system, it was assumed that major crop nutrients can be replenished back in to the soil through the application of chemical fertilizers. But along with NPK, plant requires total 16 types of macro and micro-nutrients for growth and role of soil organic matter is also important for maintaining the microbial activity of soil, this fact was neglected. As a result after 30 years of continuous use of chemical fertilizers and pesticides, its adverse effect on natural soil fertility is clearly visible on soil structure, micro-flora quality of water and food produced. Compost builds good soil texture and structure, qualities that enable soil to retain nutrients, moisture and air for the support of healthy crops. Composting is a giant step towards recycling wastes, conserving precious energy reserves and regaining control of our food supply. Backyard composting is the 1st step and the easiest. Farm scale composting is more difficult to effect, but potentially for more beneficial to the society as a whole. Higher the humus content, more moisture a soil can absorb and retain soil with ample organic matter, let's rain drops seep gently into it, instead of splattering and churning up soil particles.

Composting is the best method to utilize large amount of organic wastes. In the present experiment the *Parthenium hysterophorus*, a dreaded weed of India is taken as special bio-mass for preparation of compost through various methods like aerobic, anaerobic and through worms. The *Parthenium* weed is with high nutritive value. This nutritive potential of *Parthenium* can be utilized for increasing soil fertility. The widely growing *Parthenium* green bio-mass can be composted by using various techniques and added to soil as organic manure. Inspite of all its ill effects the *Parthenium* plant is having high nutritive value. This nutritive potential of *Parthenium* is utilized for the beneficial use of mankind by converting lots of plants into useful compost. The composting was carried out on large scale using huge amount of *Parthenium* biomass (750 Kg) by Vermi-Compost method. The experiment was carried in the premises of Mahatma Gandhi Institute of Rural Industrialization. (M.G.I.R.I.), Wardha (MS). Bio-dung vermi compost method is modern method to use exotic worms to produce worm -casts used as compost. The biomass is partially digested called as bio-dung which is used as vermi-feed.

MATERIAL AND METHODS

Biodung Vermicompost Method:

The term "vermi-composting" means the use of earthworms for composting organic residues. Earthworms can consume practically all kinds of organic matter and they can eat as much as their own body weight per day. The excreta or "casting" of earthworms are rich in nutrients (N, P and K) and also in bacterial population. The collection of vermi-cast along with

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microbial degraded organic compost is called vermi-compost. Das and Ghatnekar (1979) followed the same method for the degradation of some terrestrial and aquatic weeds to produce fermented mass under Indian conditions. They observed that when the weeds well soaked in water were enclosed in polythene bags and exposed to sun for aerobic fermentation uniformly fermented mass was formed within 15 to 20 days.

In the present investigation the same method is used to prepare the biodung from green Parthenium biomass as well as usual green biomass and then used as a vermifeed to produce vermi-compost.

In the present experiment following materials are used for the preparation of biodung.

***Parthenium* biodung**		**Usual biodung**	
1. Green Parthenium biomass	: 200 kg	1. Usual green biomass	: 200 kg
2. Cow dung (fresh)	: 5 kg	2.Cow dung (fresh)	: 5 kg
3. Water	: 100 liters	3. Water	: 100 liters
4. A thick black Polythene sheet 8' x 10'	: 01	4. A thick black polythene sheet 8' x 10'	: 01

Methodology of *Parthenium* Bio dung Preparation:

Initially 200 kg green vegetative and flowering *Parthenium* plants were collected from the *Parthenium* field. Then this Parthenium biomass was divided in to five parts each one weighing 40kg. The ground surface selected for the preparation of bio-dung was under tree shed. The ground surface was made clean and then the area 5' x 5' was marked. On this area the heap was made for biodung. Initially 6 inches layer of thick woody twigs were spread above the marked area in form of network. Above this woody network a systematic heap was prepared by piling the Parthenium biomass in to layers. Each layer was containing 40 kg of Parthenium biomass well soaked in cow dung slurry which was made by mixing 1 kg fresh cow dung in 20 liter water.

Thus five layers were made one above the other and the heap was made (photo1, 2). This heap was measured and then covered with thick black polythene sheet (photo 3).

Photo.1: Biomass sealed in the process of Heap Composting

Photo.2: Heap of Parthenium above the ground for the preparation of Bio dung

Photo.3: Heap covered with Polythene sheet during the formation of Bio - dung

The temperature was noted by removing the polythene sheet after every 24 hours from three points from bottom and 3 points from upper and also from the centre top by dipping the thermometer rod 1.5 ft deep (photo 4). Later it was immediately covered.

After 15 days a turning was given to the biomass and again covered with polythene sheet. After turning again temperature was noted after every 24 hours for another 15 days. After one month the same biomass was weighed, collected as biodung and used as raw material as vermi-feed for vermi-composting.

Photo.4: Temperature recording of Bio – dung during process

Methodology of Vermi-composting (Using *Parthenium* biodung):

For the preparation of vermi-composting a vermi-bed was made under the tin shade. The size of the bed was 4' x 3' x 1.5' (l x w x h). The bottom of vermi bed was loosely lined with brick pieces, pebbles or twigs. After 10 inches thick layer of half decomposed biomass (biodung) is placed over the basal layer of vermi bed. On this decomposed biodung 300 adult earthworms of species *Eudrilus eugeniae* were placed and then the whole vermi-bed was covered with dry grass. The bed was kept moistened with water after every 4 days. Initially for 3 days, the temperature was noted. The vermi-bed is kept undisturbed for 45 days. However it was moistened with water after every four days. After 45 days the compost was taken out and weighed and bagged.

Methodology of Vermi-composting (Using Usual biodung)

The same process is repeated by taking general green biomass of same quantity in place of *Parthenium* green biomass.

Physical and Chemical Testing Of Compost:

Methodology of sampling: Before analysis of compost the proper sampling was done. It was done by picking 15 - 20 samples from different locations after the maturation of the compost. These samples were mixed thoroughly and then sub-sampling was done as follows.

The mixed sample collected was spread in a disc like shape and divided the compost in four parts (quartering) and discarded one set of opposite quarters. Then the remaining two quarters of the compost sample were mixed thoroughly. The process was repeated till the sample size was reduced to 0.5 to 0.75 Kg. The same process of sampling is applied for every form of compost. A small amount of fresh sample is taken out for the analysis of moisture contents and rest of the sample was stored in clean polythene bag labeled and refrigerated but not frozen. These samples were the analyzed within few days of being sampled. For every analysis, the process is repeated for three samples and mean of the three is taken in the experiment. The sampling was done during the composting after 30 days, 60 days and at maturity in all methods except anaerobic process where it was done only once after maturity.

Analysis of physical parameters:

Physical parameters included color, odor, grain size, moisture content, total solid, ash, organic matter, pH and electrical conductivity (EC).

Determination of color and odor:

Color and odor was noted by observation and smell while the grain size was calculated by sieved compost, from 5 mm pore sieving machine. The amount sieved and the remains were calculated in percentage.

Determination of percent total solid and percent moisture content:

The moisture content and total solids of the compost were determined by the method described by Ranade (1970).

Determination of percent ash and volatile solids:

The percent ash was determined by Jayaraman (1996).

Determination of pH:

10 gm sample was taken in 50 ml beaker; to this 20 ml distilled water was added and stirred well for about five minutes. Then it was kept for half an hour. (In the meantime pH meter was calibrated at 4.0, 7.0 and 9.2 pH by using standard buffer solution). Then again stirred before immersing the electrodes in the solution and the pH was recorded.

Determination of Electrical Conductivity (EC):

The supernatant used in the above determination of pH, the same supernatant was used in the determination of EC. Before recording the EC, the EC meter was calibrated by standard 0.01 N KCl solutions (by dissolving 0.7456 gm dry KCl in distilled water and make it to one liter of distilled water). This solution has an electrical conductivity of 1411.8 x 10-3 i.e. 1.41 dsm-1 at 25°C. The EC of the compost samples were noted by immersing conductivity electrode (cell) in the supernatant.

Analysis of chemical parameters:

Chemical parameters included estimation of Organic Carbon, Total Nitrogen, Total Phosphorous and Total Potassium with C/N ratio present in all types of compost prepared by both *Parthenium* as well as usual green biomass.

Determination of Organic Carbon:

Walkley and Black (1973) Rapid Titration Method.

RESULTS AND DISCUSSION

Biodung vermicompost

i) Using *Parthenium* biomass: The initial heap produced by the *Parthenium* biomass for the preparation of biodung was 5' x 5' x 4' (L x W x H).

The highest temperature recorded after 24 hours was 52.7°c after 48 hours 54.2°c and maximum 57.3°c on the 3rd day in deep central part (Table-1). There after it gradually reduced (fig. 1)

At the end of 15th day the mean temp of the heap was found 46.6°c. After turning, the temperature fall-down to 35.6°c there after it gradually increased and on 8th day of turning it attained again the maximum temperature i.e. 41.1°c in the centre then again gradually fall-down and at the end of 30 days the mean temperature of the heap reaches to 34.7°c.

The height of the heap pressed down to 3 feet at the end of 15th day after 25 days large number of fungal bodies were seen on degraded *Parthenium* biomass and again pressed down and reduced to only 2 feet height at the end of 30 days. The biomass was totally black and partly digested after 30 days and called the biodung. The percentage recovery of the biomass as biodung was 46% i.e. from 200 kg green biomass 92 kg of bio-dung was produced.

From this bio-dung vermi-compost was produced after 45 days. The percentage recovery of vermi-compost was 41.30%. i.e. 92 kg partially digested biomass i.e. biodung 38 kg of vermi-compost was prepared. Harvesting of vermi-composed without worms is generally done producing heaps at number of intervals (Photo – 6).

Photo. 6: Harvesting of Vermi Compost by producing heaps at number of intervals

ii) Using usual Green biomass: The highest temperature recorded after 24 hours in the preparation of usual biodung was 54.3°c in the deep centre. It increased to 56.4°c on 2nd day and reached to 58.7°c on 3rd day. It was maximum temperature recorded during the whole process of biodung preparation. The highest mean temperature was 56.06°c and highest mean temperature of bottom layer was 54.2°c and that of upper layer was 55.3°c.

Table. 1: Temperature recorded during the process of composting by bio-dung vermicompost method using *parthenium* green biomass

Sr. No.	Days	At. Temp. in °c	Mean temp of bottom layer 6" above ground level in °c	Temp of deep center 1.5'deep from top in °c	Mean temp of upper layer 1.5' above ground level in °c	Mean temp of bio-dung in °c	Variance	Std deviation	Std error
01	01	28.6	49.8	52.7	50.8	51.1	1.4466	1.2027	0.4910
02	02	26.4	51.5	54.2	52.4	52.7	1.26	1.1224	0.4582
03	03	31.8	53.6	57.3	54.2	55.03	2.6289	1.6213	0.6619
04	05	33.2	52.8	56.9	53.6	54.43	3.1489	1.7745	0.7244
05	07	31.2	51.2	54.8	52.5	52.83	2.2155	1.4884	0.6076
06	09	26.5	49.3	51.1	50.5	50.3	0.56	0.7483	0.1971
07	11	27.8	47.1	50.8	48.5	48.8	2.3266	1.5253	0.6227
08	13	28.1	46.0	49.4	47.3	47.56	1.9630	1.4010	0.5719
09	15	27.4	45.1	48.3	46.4	46.6	1.7266	1.3140	0.5364
				ONE TURNING AFTER 15 DAYS					
10	16	30.9	34.9	35.6	35.0	35.16	0.0956	0.3091	0.1261
11	17	30.1	35.4.	35.9	35.4	35.56	0.0696	0.2638	0.1076
12	18	26.5	36.0	36.7	36.1	36.26	0.0956	0.3091	0.1261
13	19	28.4	37.5	38.2	37.6	37.66.	0.1069	0.3270	0.1311
14	21	26.6	38.7	40.0	38.8	39.16	0.3489	0.5907	0.2411
15	23	25.8	39.2	41.1	39.3	39.86	0.7622	0.8730	0.3564
16	25	27.6	37.3	39.3	37.2	37.93	0.9355	0.9672	0.3948
17	27	28.1	36.3	37.4	36.3	36.66	0.2689	0.5185	0.2116
18	29	27.6	35.2	35.9	35.1	35.4	0.1266	0.3559	0.1453
19	30	28.3	34.5	35.2	34,4	34.7	0.1266	0.3559	0.1453
20	31	29.4	34.3	34.9	34.2	34.46	0.0956	0.3091	0.1261

At the time of turning i.e. after 15 days the highest temperature was 48.8°c in deep centre and mean temperature of bio-dung was 47.26°c. After turning the temperature was fall down to 35.7°c in the deep centre and then gradually increased to 43.1°c after 10 days of turning but did not reach 48.8°c and again fall down gradually (Table-2).

After next 15 days of turning i.e. after 30 days a temperature fall down to 35.7°c in the deep centre and mean was 37.33°c. After 30 days the partially digested biodung was enough degraded to be used as vermifeed. The difference between the bottom layer temperature and deep centre ranged between 2.6°c to 4.5°c in first fifteen days and 0.3°c to 1.0°c in next 15

days. The difference between the deep centre and upper layer mean temperature ranged from 2°c to 3.4°c in first 15 days and 0.2°c to 0.8°c in next 15 days. At the end of 30 days the highest mean temperature 56.06°c gradually reduced to 37.33°c. (Fig.-2). After 15 days the height of biodung heap was automatically pressed down 1.5 feet.

Table.2: Temperature Recorded During the Process of Composting By Bio-Dung Vermicompost Method Using Usual Green Biomass

Sr. No.	Days	At. Temp. in °c	Mean temp of bottom layer 6" above ground level in °c	Temp of deep centre 1.5'deep from top in °c	Mean temp of upper layer 1.5'above ground level in °c	Mean temp of bio-dung in °c	Variance	Std deviation	Std error
01	01	28.6	50.8	54.3	51.5	52.2	2.286	1.512	0.6172
02	02	26.4	52.8	56.4	53.1	54.1	2.66	1.630	0.6654
03	03	31.8	54.2	58.7	55.3	56.06	3.6689	1.915	0.7818
04	05	33.2	53.7	57.1	54.4	55.06	21.48	1.485	0.6062
06	09	26.5	50.5	52.2	51.1	51.26	0.4956	0.7039	0.2873
07	11	27.8	48.3	51.1	49.2	49.53	1.3622	1.1671	0.4764
08	13	28.1	47.1	49.9	48.0	48.33	1.4206	1.1919	0.4866
09	15	27.4	46.2	48.8	46.8	47.26	1.2356	1.1115	0.4537
ONE TURNING AFTER 15 DAYS									
10	16	30.9	34.8	35.7	35.1	35.2	0.14	0.3741	0.1527
11	17	30.1	35.2	36.0	35.5	35.56	0.1089	0.3300	0.1347
12	18	26.5	35.9	36.9	36.1	36.3	0.2266	0.4760	0.1943
13	19	28.4	38.3	38.8	38.3	38.46	0.0556	0.2357	0.0962
14	21	26.6	40.3	40.9	40.5	40.56	0.0622	0.2495	0.1018
15	23	25.8	41.8	42.4	41.9	42.03	0.0689	0.2624	0.1071
16	25	27.6	42.5	43.1	42.7	42.76	0.0622	0.2495	0.1018
17	27	28.1	40.3	41.0	40.4	40.56	0.0956	0.3091	0.1261
18	29	27.6	38.4	39.2	38.6	38.73	0.1155	0.3399	0.1387
19	30	28.3	37.2	37.5	37.3	37.33	0.0155	0.1247	0.0509
20	31	29.4	35.9	36.3	36.0	36.06	0.2893	0.1700	0.0694
21	32	29.6	34.9	35.2	35.0	35.00	0.0266	0.1632	0.0666

Table. 3: Physical Parameters Of Compost After Maturity

S.No	Biomass used	Method	% of Moisture	% of total Solid	% of Ash	% of Organic matter	pH	EC ms cm^{-1}
1.	*Parthenium* green biomass	Vermi-compost	56.12	43.88	65.03	34.97	8.15	0.82
2.	Usual Green biomass	Vermi-compost	45.98	54.02	68.07	31.93	8.12	0.75

The percentage recovery of usual biodung formation was 56% from this biodung 58.92% vermi-compost was produced, after 45 days in vermi-bed. This compost was granular but with more moisture. The sample was taken out to calculate moisture and then shed dried and bagged. The bag was then labeled and stored. Vermi-compost when tested for viability of any weed seed, no weed seed germination was found in the indoor pot.

In *Parthenium* biomass as it contains the toxic substance sesquiterpene lactone, the people were of opinion that it cannot be converted into vermi compost. In the present experiment the *Parthenium* biodung was successfully converted in to vermi-compost giving good results regarding nutrient status. When quality of compost was considered the external appearance, particle size and odor of all aerobic compost of *Parthenium* biomass was quite similar to that of usual compost. The P^H of all *Parthenium* composts was above 7.35 and maximum 8.07. The neutral or slightly alkaline compost is suitable for near about all types of plants. Thus *Parthenium* compost is suitable for the plants. The P^H above the 7.4 also reduces or minimizes the availability of heavy metals.

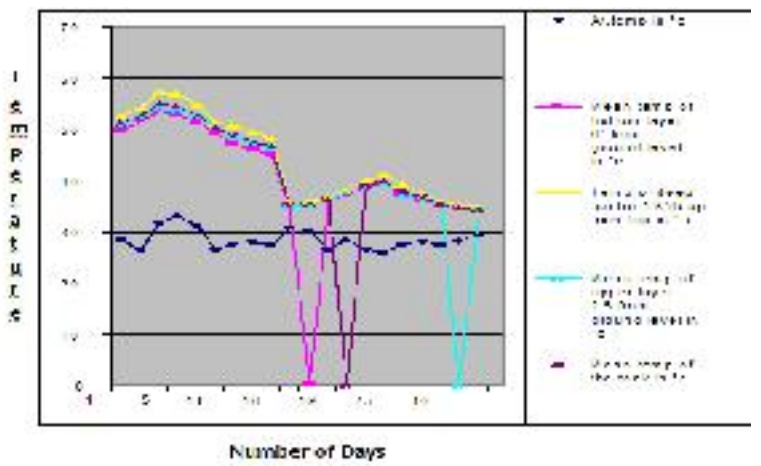

Fig. 1: Temperature Variation During The Process Of Composting By Bio-Dung Vermicompost Method Using *Parthenium* Green Biomass Number of Days

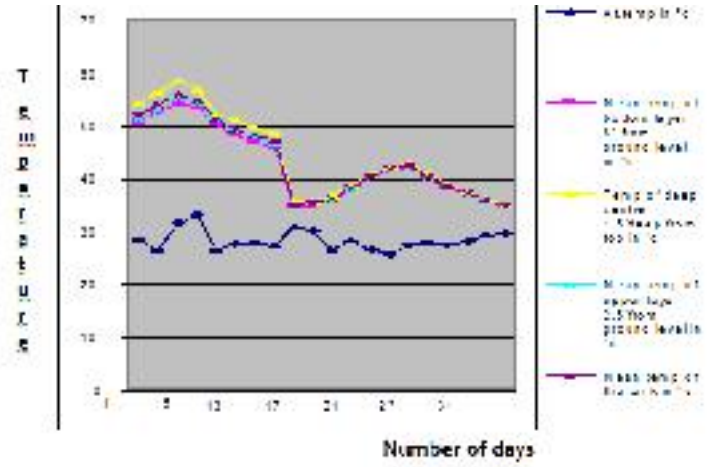

Fig. 2: Temperature Variation During The Process Of Composting By Bio-Dung Vermicompost Method Using Usual Green Biomass

Electrical Conductivity (EC) of compost below > 1 mS cm^{-1} is tolerable by maximum plants. In this experiment all the composts prepared by *Parthenium* biomass also showed EC below 1 $mScm^{-1}$, Phytotoxic composts show more EC.

The biomass with less C/N ratio or green biomass degrades fast. Biomass with greater C/N ratio requires addition of nitrogenous materials to the biomass. *Parthenium* plant is with less C/N ratio thus does not require addition of any nitrogenous material. The phosphorus, a major plant nutrient is more in *Parthenium* compost thus *Parthenium* compost can be used as phosphate rich compost. Thus by no means the *Parthenium* compost is harmful or with less nutritive value or with adverse effects. All aspects which are considered in compost regarding its quality are quite good. Farmers can use this *Parthenium* plant without any doubt in their regular composting. In present experiment no pesticide was required as no diseases were observed on the plants throughout their growth. Only fungal growth seen on degrading *Parthenium* biomass (Photo-5) which is beneficial for degrading biodung. Hence compost is of dual benefits, it reduces the chances of pest attack. It improves the soil texture and nutrient status. It has long term effect on crop plants as well as on yield.

Photo .5: Fungal growth seen on degrading *Parthenium* biomass production in Bio - dung

Table. 4: Chemical Parameters Of Compost After Maturity

Sr. No	Biomass used	Method	% C	% N	% P	% K	C/N ratio
1.	*Parthenium* green biomass	Vermi-compost	20.28	1.55	0.58	1.14	13.08
2.	Usual Green biomass	Vermi-compost	18.51	1.11	0.41	0.84	16.67

More amount of phosphorus is found in *Parthenium* compost so it can be used as phosphorus rich compost. Electrical conductivity of the *Parthenium* compost was found >1$mScm^{-1}$ i.e. most tolerable for the growth of the plants. Thus *Parthenium* which is said to be curse for the bio-diversity is converted here for the most beneficial use of the mankind.

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Source of support: Nil
Conflict of interest: None Declared