PRODUCING MANURE BY VERMI "COMPOSTING NATURAL", AGRO BASED AND ANTHROPOGENIC "ORGANIC WASTE" MATERIALS

M.R. Vijaya Kumar[1] and Yeriswamy G[2]

Abstract:
It is well known and established fact since long time, that, the Manure made from organic sources is always the ideal material to supplement nutrients to various crops and plants. It is proven beyond any ambiguity that, the mineral fertilizers, in practice have caused more destruction of nature and sufferings to humans and animals than benefits to farming. This approach to boost agricultural yield is non-sustainable and humans have to recall that ancient system of administering organic manure is the perfect pathway to better yields. In this background a work is carried out with multiple organic waste materials employed to produce manure and one predominant earth worm specie eisenia foetida used for composting. Various materials used in the research work are Organic solid waste from the city, Baggase, maize outer layer, Papaya peels, Banana peels, Gliricidias leaves, Algae leaves, Acacia leaves, river weed, Duck weed, Parthenium, different grasses, waste tea powder etc. Pit, Bin and Tray methods are adopted to yield different results. Also the materials mentioned are used in dissimilar combinations, with an aim of arriving at distinguishable output and to identify a best possible combination among them. All the three methods were applied and finally five samples of compost are tested for NPK values from University of Agricultural sciences, Raichur, Karnataka. At the end of project good enriched compost is obtained in approximately twenty to twenty five days. The results are very encouraging and it is concluded that the manure developed could be used for agricultural applications.

Keywords: compost, manure, Eisenia foetida, grass, peelings, bagasse, organic, Nitrogen ,phosphorous, potassium.

[1] *Associate professor, Department of Civil Engineering, R.Y.M.E.College, Ballary-583104, INDIA.*
mrvk.rymec@gmail.com
[2] *Assistant Engineer, R.D.W.S.SD Sub Division, Siruguppa-58312*

DOI: - 10.31838/ecb/2023.12.si5.052

I. Introduction

The Agriculture in India has always been the backbone of the Indian economy and has been selfsustained since long time. Agriculture industry contributes up to 30% to GDP of the total GDP. The Soil fertility and nutrients available have direct impact on the crops and vegetable plants yield. Farmers always have tried diverse methods to increase agriculture yield and productivity for gain and prosperity. In this venture many efforts such as use of Fertilizers and various other chemicals is practiced in different parts of the country, without understanding its implications.

This eventually has lead to some serious adverse side effects on the Environment and ecosystems. In a paper published by **Nagavallemma, KP**[5] et all, have highlighted the unchecked use of mineral fertilizers and its implications on deterioration of environment, pollution of water resources, and effect on soil fertility. Hence there is a dire need to educate farmers and peasants about Environmental complexities against use of such methods. The complexities range from contaminating the soil, polluting surface water bodies, ground water etc and affecting the ecosystems. This eventually led to some serious social and environmental problems such as causing cancerous diseases in humans and addition of toxic and non-biodegradable chemicals into natural water bodies. As a result, this called for different approaches which possibly provide nutrients to crops and plants that are ecofriendly and safe. A fertile soil can demonstrate an increase in harvest by two to three times, in comparison to a infertile soil or soil which is deficit in nutrients.

In this direction a study has been done by **Manuel Blouin**[7] who has demonstrated in his paper, that the plants and crops Biomass significantly increased, after the use of manure especially in legumes. There is direct raise in yield up to 26%, when compost is applied. Composting is one of the oldest and natural avenues to fulfill the crop requirements. Thus a study is taken up here to develop manure, using various wastes as mentioned earlier. In a paper published by ***Sunil J Kulkarni***[4],it is explained as vermicomposting itself is a boon, and have described how waste management is taken care by recycling it to improve agricultural output and for the better cause of mankind. Extensive research is made in the past and numerous organic materials, different kinds of worms and diverse composting environment are the variables emphasized in the studies. The nature of humus produced depends on the type of organic feed, type of worm and bacterial species involved in the composting process. The influence of bacterial communities present in the guts of earthworms on the quality of compost has been highlighted by **Jorge Domingues**[3] in their research work and have explained in detail about decomposition of organic matter inside the intestines of earthworms. The advantages are multifold, as organic waste from city and also many house hold wastes are applied as raw materials, making it cost-effective. As the composting process is biological, there are no complications or complexities like involvement of chemicals, as it happens in the application of fertilizers. This is studied well by **Sarat Ganti**[6], in their paper "vermicomposting" published in International journal of waste resources in which paper and food waste are regarded as raw organic materials. The methodology used in the study is simple and is effective because of this reason. The earthworm, used in the project is *Red earth worm*, available in plenty and can be nurtured easily to higher populations. The scientific name of the worms employed is *eisenia* fetida. *The vermin composting using different organic materials is deeply studied by* ***Ramanarain***[1] *et all, in their paper" Vermi composting of different organic materials using the epigeic Earth worm Eisena foetida" and used extensively agro products to produce Compost.* Even it is possible to apply multiple number of worms to compost, but in this work, only this worm was involved. The earth worms can be cultured in numerous numbers in laboratory by maintaining acclimatized environment for them. These worms critically require three entities for their multiplication viz humidity, habitual temperature and proper food mean, the, organic matter. In this study a wide range of organic material forms have been used, involving, wastes from cities, natural and other agro based materials. A paper published by **Magit Olle**[8] demonstrates the use of paper waste, grass and cow dung wastes and it is observed, profuse multiplication of earth worms (**Eisenia Fetida)** and also significant reduction in both organic carbon and some heavy metals in the waste. The compost produced in the study is extremely simple, and the procedure can be adopted right from domestic to large scale municipal or corporation level applications. To meet this approach three levels of composting i)Pit ii) Bin and Tray is dealt with. The labour required is also plausible and individuals in rural areas or villages can easily accept and embrace and practice this.

The compost so prepared should be tested for its

suitability as manure for its NPK nutrient composition. Regarding this the peasants are to be educated for best crop yields, considering the type and nature of crop. Meanwhile soil fertility can also be a part of investigation, with respect to type of soil, its organic content, p^H, salinity along with the microbial activities. Further multiple number of earth worms can be applied, if available and the quality of compost from different worm combinations can be investigated. During this project, only one kind of worm was available and the same species is applied.

The important part of the work is the use a wide variety or array of organic materials, especially giving weightage to agricultural products and other naturally available flora, for composting, as the materials available may be dissimilar and diverse at different places. A research work made by **Mousavi S A[9],** the key raw organic materials employed are grass, paper waste and cow dung with Eisenia fetida as the instrument to work inside soil media and studied changes in physicochemical properties of soil, such as effect on organic carbon and decline in concentration of heavy metals also. *In another paper published by* ***Thota tulsi[2]****, vermin compost preparation from plant debris, excellent quality compost was prepared but it has taken 60 days time for the same*. Thus the applicability of the study acquires good potential and is encouraging to the farmers. The results of the study can be enforced by city corporation bodies on farmers or the bodies can implement the same themselves. At the end of the above briefing, every individual will acknowledge, admit and come to concurrence that, we can use nature, apply natural mechanisms and transform annoying and problematic wastes into ecofriendly substances of immense benefits to mankind. Even abundant revenue can be generated by Government bodies by effective implementation of the stated processes and commercialized.

II. Experimental program:

The work carried out is divided into the following stages:

I. Selection of materials**.**
II. Selection of Earth worms
III. Selection of composting units.

The raw organic materials used for composting are mainly borrowed from the city solid waste, and various other daily disposed fruits and vegetables wastes and agriculture-based substances. Even some grasses and different water weeds are also used in the study. The list of such materials used is presented in the table below:

Table No: 1.Material detals:

Sl No	Materials Used
1	Organic solid waste from the city
2	Baggase, maize/corn outer layer, Papaya peels, Banana peels
3	Gliricidias leaves, Algae , Acacia leaves
4	River weed, Duck weed, Partheniоum
5	Different grass, Waste tea powder

The red earth worm which is the key and sole worm used has the following characteristics:

Table No:02: Characters of earthworm:

Characters	Eisenia fetida
Body length	3-10cm
Body weight	0.4-0.5g
Maturity	50-55days
Conversion rate	2.0q/500worms/2 months
Cocoon production	1 in every 3 days

Composting Units: As spoken earlier three composting unit types are used in the work:
i) PIT
ii)BINS
iii)TRAYS.

Considering different size units, provides more flexibility to carryout composting in terms of amount and type of organic materials available and also the quantum of compost required.
The Figure below shows the Eisenia Foetida earthworm species used in the work.

Fig 01: Eisenia Foetida

The combinations of nutrients adopted to feed worms is shown in Table No 03.

Table No:03

Materials	Combination I %	Combination II %
Organic solid waste from the city	**50**	**60**
Baggase, corn outer layer, Papaya peels, Banana peels	**20**	**10**
Gliricidias leaves, Algae leaves, Acacia leaves	**10**	**10**
River weed, Duck weed, Partheniоum	**15**	**15**
Different grass, Waste tea powder	**5**	**5**

I.PIT METHOD:
A pit of size 6x3x2 feet is constructed in the backyard of the Department using 4 inch brick wall and walls are well plastered both sides. A thin layer of bed concrete is put and a drainage outlet is provided to drain out excess water.

Fig No: 02: Pit loaded with organic material.

The various steps involved are narrated below:
❖ Construct a pit of 6*3*2 feet size (L*W*D) over hard ground using bricks.
❖ Fill the pit with following four layers:
i)1st layer-sand or sandy soil of 5-6cm. This layer helps to drain excess water from the pit.
ii)2nd layer- vegetable waste, duck weed, river weed, Different grass, Waste tea powder, Gliricidias leaves, Algae leaves, Acacia leaves, Baggase, corn outer layer, Papaya peels, Banana peels of 30cm above 1st layer which will be used for providing aeration to the pit.
iii)3rd layer-15 to 30 days old dung over paddy straw layer at a thickness of 20-30 cm. This helps in initiating microbial activity.
iv) 4th layer-pre-digested material about 50cm thick.
Inoculate earthworm @ 1000 worms per square meter area or 1 kg earthworm in 100kg of organic matter. Spray water on the bed and gunny bag. Maintain 50-60% moisture in the pit by periodical water spraying.
The composting unit is constructed in a cool, moist and shady place. Cow dung, dried leaves and other raw materials are mixed and is allowed to undergo partial decomposition and a thickness of 15 to 20 cm is maintained. This material is applied at the pit bottom Then the Red earth worms (150- 200 numbers) are released on the top of this bed and followed by Water is sprinkled by sprayers immediately and pit is kept moist continuously.
Bed should be turned once after every 3 days for

Figure No 03. Pit filled with maize coverings air circulation and to accelerate decomposition.

Composting occurred in around 25 to 30 days and the final volume of raw materials was reduced to (1/4) th, or 25% of initial volume.

Figure No: 04: Corn and other organic matter loaded in to the bin.

II. BIN METHOD:
Bin composting methods operate in a similar way to the aerated pit method. They lack good aeration, achieved as in pit method. But periodical turning of the floor of the bin is very essential to reverse the materials. Occasional remixing of material in the bins can speed up the composting process.. The basic methodology as applicable for the aerated pit also applies to bin composting. If depth of bin is more, there is a greater degree of compaction and a greater depth of materials for air to pass through. Bins use is encouraged, where composting is attempted in residences and raw materials are generated in less quantity.

Bin is loaded as narrated below:
- 1st layer-maize/corn outer layer of 5-6cm.
- 2nd layer- vegetable waste, duck weed, river weed, Different grass, Waste tea powder, Gliricidias leaves, Algae leaves, Acacia leaves, Baggase, , Papaya peels, Banana peels of 3cm each layer above 1st layer which will be used for providing aeration to the bin.

- 3rd layer-15 to 30 days old dung over paddy straw layer at a thickness of 20-30 cm. This helps in initiating microbial activity.
- 4th layer-pre-digested material about 50cm
- Inoculate earthworm @ 1000 worms per square meter area or 1 kg earthworm in 100kg of organic matter.
- Spray water on the bed and gunny bag. Maintain 50-60% moisture of the pit by periodical water spraying.

Fig No: 05: Cow dung loaded over corn layer

The worms, cultured in the department, were introduced into Pit, Bin ,Tray with other various organic materials as illustrated earlier.

Fig No: 06. Bin loaded with bagasse and other materials.

III.TRAY METHOD:

In composting using Tray's three types of trays are employed. The intention of selecting three trays is to have dissimilar organic matter compositions and their by affecting the character of compost produced.

- Tray-1: In these tray Natural ingredients like organic matter, leaves, waste cabbage and garden waste are added.

Fig No:07: Tray type 01.

- Tray-2: In this tray Solid waste combinations like soil, alternative ayer of organic matter, solid waste, fruit peelings, cow dung and urine are added.

Fig No: 08: Tray type 02.

Tray-3: In this tray Agricultural waste like bagasse, corn outer layer, algae, riverweed, and duck weed are added.

Figure No: 09. Tray type 3.

Steps for Vermi-composting in Trays: In the trays, first a perforated plastic flexible wire mesh is laid.

- Soil and sand are mixed in the proportion 3:1.and is applied as the bottom base layer in the trays.
- Above this soil-sand bed first cow dung is placed. In Tray 1 above this layer, natural ingredients like organic matter, leaves, cabbage waste and garden waste are laid.
- In tray 2 above cow dung layer solid waste, fruit peelings are laid.
- In tray 3 above the cow dung layer, Agricultural wastes like bagasse, corn outer layer, algae, river weed and duck weed are laid.
- Red earth worms of around 150 to 200 number are released on these layers followed by sprinkling water immediately to maintain moisture and humidity in the media. Watering is maintained every three days once to maintain moisture in the soil.

Also the bed material is turned upside down evry three days once, to augment aeration and promote decomposition.

Compost formation was observed and same is confirmed after 20 to 30 days, and is confirmed by the change in color and smell of all organic constituents.

The Black and grayish compost is collected separately from all the above three methods and packed in plastic polythene bags to dispatch for its evaluation.

The compost was submitted to Near by **UNIVERSITY OF AGRICULTURAL SCIENCES** located in Raichur City, Karnataka, India with a request to analyze for Nitrogen, phosphorous and Potassium , the essential nutrients for growth of diverse crops.
The composting duration as observed in the study is presented in Table below for different methods:

Table No:04. Composting duration for different methods.

SL NO	Composting Methods		DURATION DAYS
01	Pit method		28
02	Bin method		20
03	Tray method	Natural ingredients	18
		Solid-waste combinations	23
		Agricultural waste	27

IV. Evaluation of compost for NPK nutrients:
At the end of the investigation, it is important to evaluate the compost generated and find out its suitability as a manure for agricultural applications.

For this, the compost samples shown below are submitted to University of Agricultural sciences, Laboratory, located at Raichur, Karnataka, India and percentages of Nitrogen, potassium and Phosphorous are found out.

The samples of compost submitted are exhibited below:
Total of Five samples were spawn, where three samples produced from three trays, one sample from bin and one sample from pit sources. The five compost samples sealed and ready to dispatch to university are shown below:

Figure No 10: Compost samples.
The samples were sent to to Dept of Soil Science, University of Agricultural Sciences, Raichur–584102, KARNATAKA, INDIA, a renowned and reputed laboratory to check the NPK valves of manure sample.The results after the evaluation are presented in Tables below:

TRAY COMPOSTING:
Analysis of Sample 01: Sample in Tray no 1 is loaded with "Natural ingredients" like leaves, vegetable wastes + garden waste + paper waste + soil + old cow dung.

Table No:05: N-P-K,analysis of Sample 01:

SL.No	Parameter	Percentage value
01.	Nitrogen (N)%	0.87
02.	Phosphorus (P)%	0.59
03	Potassium (K)%	0.62

Analysis of Sample 02: Sample 2 is collected from Tray no 2 and is added with constituents "Solid waste combinations" like fruit peelings + cow dung + urine + solid waste from kitchen + soil.

Table No: 06: N-P-K analysis of Sample 02:

SL.No	Parameter	Percentage value
01.	Nitrogen (N)%	0.92
02.	Phosphorus (P)%	0.69
03.	Potassium (K)%	0.89

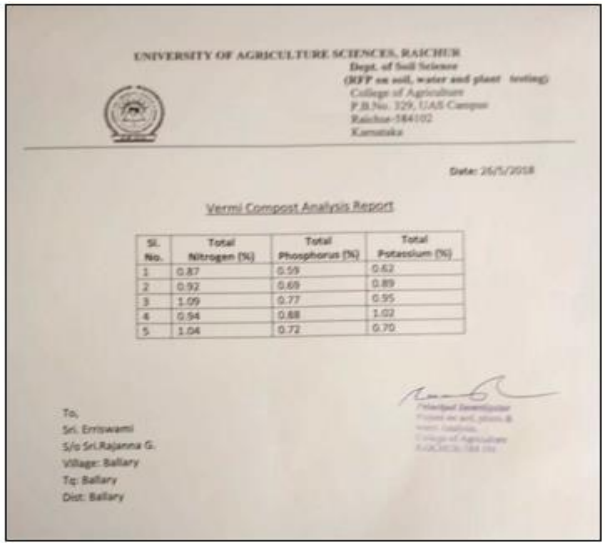
Analysis of Sample 03: Sample 3 is collected from Tray no 3"compraisng of materials ,Agricultural waste" like bagasse, corn outer layer + tea powder + algae + duck weed + river weed + alternate layer of old cow dung + soil.

Table No: 07: N-P-K analysis of Sample 03:

SL.No	**Parameter**	**Percentage value**
01.	**Nitrogen (N)%**	**1.09**
02.	**Phosphorus (P)%**	**0.77**
03	**Potassium (K)%**	**0.95**

BIN COMPOSTING:
Analysis of Sample 04: Sample 4 is compost produced from Bin method and various combination of Organic materials like solid waste from the city + Baggase + Corn outer layer + Papaya peels + Banana peels + Gliricidias leaves +

Algae leaves + Acacia leaves + River weed + Duck weed + Different gross + Waste tea powder + old cow dung are applied into the bin.



UNIVERSITY OF AGRICULTURE SCIENCES, RAICHUR
Dept. of Soil Science
(RFP on soil, water and plant testing)
College of Agriculture
P.B.No. 329, UAS Campus
Raichur-584102
Karnataka

Date: 26/5/2018

Vermi Compost Analysis Report

Sl. No.	Total Nitrogen (%)	Total Phosphorus (%)	Total Potassium (%)
1	0.87	0.59	0.62
2	0.92	0.69	0.89
3	1.09	0.77	0.95
4	0.94	0.88	1.02
5	1.04	0.72	0.70

To,
Sri. Erriswami
S/o Sri.Rajanna G.
Village: Ballary
Tq: Ballary
Dist: Ballary

Figure No:11. N-P-K status of Compost samples.

Table No: 08: N-P-K analysis of Sample 04:

SL.No	Parameter	Percentage value
01	Nitrogen (N)%	0.94
02	Phosphorus (P)%	0.88
03	Potassium (K)%	1.02

PIT COMPOSTING:

Analysis of Sample 05: Sample 5 is compost produced from Pit method and various Organic materials like solid waste from the city + Baggase + Corn outer layer + Papaya peels + Banana peels + Gliricidias leaves + Algae leaves + Acacia leaves + River weed + Duck weed + Different gross + Waste tea powder + soil + old cow are applied in to the Pit.

Table No:09: N-P-K analysis of Sample no 05.

SL.No	Parameter	Percentage Value
01.	Nitrogen (N)%	1.04
02.	Phosphorus (P)%	0..72
03.	Potassium (K)%	0.70

Conclusions:

The following conclusions are drawn based on N-P-K status of compost samples:

1. That, not only direct organic waste of any city is used for composting, but many other agricultural products and different types of weeds and grasses can also be composted.
2. A wide range of waste and natural materials as listed below are found suitable to apply as raw material for composting.

1. Organic solid waste from the city
2. Baggase
3. Corn outer layer
4. Papaya peels
5. Banana peels
6. Gliricidias leaves
7. Algae leaves
8. Acacia leaves
9. River weed
10. Duck weed
11. Different gross
12. Waste tea powder.

3. The composting process was completed within 20-30 days as observed in the study.
4. Only one kind of Erath worm "**Eisenia foetida**" popularly called as red earth worms is used in the project. Hence it can be projected that, if multiple kinds of worms are employed, then better and exceptional results can be expected and also, more diverse materials as feed can be achievable.
5. It is well known that, optimum N-P-K ratio varies depending on the type of crop/vegetable. Too high or too low values are damaging to proper crop/plant growths.
6. The optimum values of range of % of Nitrogen , Phosphorous and Potassium for Agricultural crops is 1.75 to 3.0, 0.26 to 0.5 and 1.5 to 3.0 respectively.
7. The values of Nitrogen from all the Five samples varied from a low of 0.87 to 1.09 % which is lower than average required values, but just satisfies minimum required Nitrogen content.
8. The values of Phosphorous from all the Five samples varied from a low value of 0.59 to 0.88 %, which is slightly higher than the average Phosphorous % content.
9. The values of Potassium from all the Five samples varied from a minimum value of 0.62 to a maximum of 1.02 %, which just satisfies the marginal requirement.
10. Among all the manure samples, sample three and five are better enough as two elements meet the minimum requirements. Sample 3 is tray approach and sample 5 is pit approach. Sample 3 contains more natural raw ingredients and samples five contains more of city organic waste and lot other various natural and agro wastes.

Note: The project is sponsored by Karnataka State Council for Science and Technology, Indian Institute of Science Campus, Bangalore, INDIA.

References:

1. " Vermi composting of different organic materials using the epigeic earthworm Eisenia

foetida" Paper published In "International journal of Recycling of Organic waste in Agriculture" by Yvonne Indrani Ramnarain, Abdullah Adi Ansari and Lydia and Ori, 23-36, 25 th October, 2018.
2. Vermi compost Preparation from Plant Debris, Cattle Dung and Paper Waste by Using Three Varieties of Earthworms in Green Fields Institute of Agriculture, Research and Training, Vijayawada(AP), India, Paper published in "Current Agriculture Research journal" by Alla Lakshmi Manohar,
3. Thota Tulasi, Lakshmi Prasanna Gajjela, M.Devi Ajay Prasad, Nalajala Gopi, Shaik Mobeema Komanpally Rajesh, Sriramoji Srinivas, Lakshmana Swamy Parasa[3*] Volume 4, Number 1, May 2016.
4. "Changes in the composition and function of bacterial communities during vermin composting may explain beneficial properties of vermin compost" Paper Published in "scientific Reports Nature" by Jorge Dominguez , Manuel Air et all , Article number 9657 , 4 th July, 2019.
5. Vermi composting - A Boon for Waste Minimization and Soil Quality, by Sunil J Kulkarni, Published in International journal of Research and Review, Volume 4, Issue 2, February 2017.
6. Vermi composting: Recycling Wastes into Valuable Organic Fertilizer- a paper published by Nagavallemma KP, Wani SP, Stephane Lacroix, Padmaja VV, Vineela C, Babu Rao M and Sahrawat KL. 2004, published in ICRISAT, August 2006, Volume 2, Issue 1.
7. Vermi composting- paper published by Sarat Ganti, in International Journal of waste resources, January 2018, Volume 8, issue 2.
8. Vermi compost significantly affects plant growth. A meta-analysis,paper published in "Agronomy for sustainable development" by Manuel Blouin,Julien Barrere, Nicolas Meyer, Silene Latrigue, Sebastein Barot & Jerome Mathieu, 17, June 2019,Article number 34.
9. review: vermi compost, its importance and benefit in agriculture.Paper published in "Journal of Agriculture Science" by Magit Olle, 2019, PN 93-98. doi: 10.15159/jas.19.19.
10. Vermi composting of grass and newspaper waste mixed with cow dung using Eisenia fetida: physicochemical changes, Paper published by Mousavi s a , Sader S.R., Farhadi F, Faraji M and Falahi F, In Journal "Global NEST, Volume 22, Issue 1, PP 8-14,

Photo Gallery:

FIG NO 01: Ingredients used in the study.

FIG NO 02: Project members preparing ingredients.

FIG NO 03: Project Team displaying the compost developed.

FIG NO 04: Compost samples ready for Laboratory analysis.