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Variation of Vermicompost Quality Produced By Different Earthworm Species Using Rural and Urban Garbage

ZOOLOGY

KEYWORDS : Vermi species, NPK status, remarkable variations, 7 days' interval.

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ABSTRACT

Vermicompost took place its own position in crop cultivation by modern scientific concept. Three different earthworm species namely (i) Eisenia foetidaee, (ii) Eudrillus euginae and (iii) Pheretima posthuma were collected from PallaviVermi Farm, Saraitikar Road, Burdwan, West Bengal and allowed to grow in separate vat containing urban and rural garbage. The percentage of nitrogen, phosphate and potash were measured in seven days' interval taking vermicompost from each and every earthworm experimental vat. Uniform numbers of earthworms were released initially in each vat and the cocoons were counted in every week. Graphical representation of each vermi species was plotted against duration and compost quantity. The remarkable variations of results were observed which have been cited in this experiment.

Introduction:

India, our country, which has more than 1.25 billion of population, has 70% dependent on agricultural work. Indeed, the cultivable land is decreasing day by day due to urbanization and industrialization of the country. Naturally, competition for application of fertilizers in the specific unit of crop fields is being conducted by farmers to obtain highest yield of each and every cropland from a specific unit area. Continuous use of unmeasured quantity of chemical fertilizers and thereafter insecticides is making the soil polluted, harmful and sterile day by day. To combat all these hindrances there is no proper way to use any fertilizer without application of organic manures. Especially, in developing countries (Kuttar and Duff, 1981), farmers usually prefer to use chemical fertilizers due to easy availability in the market and rapid plant growth since a couple of decades. But these fertilizers are bringing harmful effect by inviting various insects and fungi. As a result, various insecticides and fungicidal chemicals are being used to protect the crop plants properly. However, concerns are rising about them causing investment with low return. Moreover, it is assumed that the application of chemical insecticides and fungicides causes carcinogenic as well as other health hazards (Jensen, 2002, FAO, 2010, Dominguez, 2004, Ismail, 1997, Gutierrez-Miceli, 2011, Brown et al., 2000). So, now-a-days we can easily understand the essentiality of the application of biofertilizers in the crop field to save our environment (Baker 1978, Herdt 1982).

Any sort of photosynthetic organism when converted to solid waste as well as any sort of bio-degradable compound can be utilized for the vermiculture program (Guitterez-Miceli, 2011, Sing et al., 2010). But in fact, urban and rural wastes are very much different in composition which was used in our experiment. Indeed, the quality of vermicompost depends on the composition of raw materials used for vermiculture programs. It is also variable on the earthworm species used for the vermiculture program (Lavelle, 1992).

Keeping all these views in mind this experiment was conducted to observe the efficiency of different earthworm species in different type of garbage constitutions.

Materials and Methods:

Materials

Three types of earthworm species viz, *Eisenia foetidaee, Pheretima posthuma* and *Eudrillus euginae* were collected from Pallavi Vermi Farm, Burdwan in the year 2014. All these earthworm species were allowed to grow in the vat separately for a month. Different parameters viz, i) NPK quantity ii) Earthworm population iii) Quantity of compost were studied during the investigation period. As the life cycle of earthworm requires 18-22 days, we allowed them to grow in the vat for 30 days so that less cocoon can be damaged till harvesting. Garbage was initially neutralized in the neutralizing vat for two weeks to standardize the pH of the compost before using experimental vat.

NPK measuring kits was used to estimate the NPK quantity in the compost in one week intervals.

Methods

protocol

(i) Available nitrogen (N)

The available nitrogen (N) of the soil was estimated through the hot alkaline potassium permanganate method as suggested by Subbiah and Asija (1956).

(ii) Available phosphorus (P)

Available phosphorus (P) of soil is determined by using Olsen's method. In this method, the extractant is 0.5M $NaHCO_3$ solution adjusted to pH 8.5 with 10% NaOH.

(v) Available potassium (K)

Available potassium content of the soil was determined by flame photometer after extraction with neutral normal ammonium acetate solution as described by Jackson (1973).

Results and Discussion

Results

Date-wise results of different status of vermicompost in each earthworm species were observed and all these data were noted critically which have been tabulated in these tables stated below (Table 1 to 30):

Table 1: Status of vermicompost (Rural garbage) in 1st day (*Eisenia foetidae*)

Earthworm Species	No. of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	Nil	0.31	0.24	0.21	200kg	nil	nil

Table 2: Status of vermicompost (Rural garbage) after 1 week (*Eisenia foetidae*)

Earthworm Species	No. of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	Nil	0.31	0.24	0.21	199.25kg	nil	Nil

Table 3: Status of vermicompost (Rural garbage) after 2 week (*Eisenia foetidae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	Nil	2.68	1.08	0.90	198.5kg	nil	Nil

Table 4: Status of vermicompost (Rural garbage) after 3 week (*Eisenia foetidae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	501	4.39	3.24	2.28	196.70kg	130	501

Table 5: Status of vermicompost (Rural garbage) after 4 week (*Eisenia foetidae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	Nil	11.84	5.84	4.66	195.8kg	625	0

Table 6: Status of vermicompost (Rural garbage) in 1st day (*Pheretima posthuma*)

Earthworm Species	No. of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	Nil	0.11	0.14	0.12	200kg	nil	nil

Table 7: Status of vermicompost (Rural garbage) after 1 week (*Pheretima posthuma*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	Nil	0.11	0.15	0.12	199.6kg	nil	nil

Table 8: Status of vermicompost (Rural garbage) after 2 week (*Pheretima posthuma*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	Nil	1.18	0.86	0.80	199.15kg	nil	nil

Table 9: Status of vermicompost (Rural garbage) after 3 week (*Pheretima posthuma*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	411	2.24	2.39	1.96	197.7kg	62	411

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Table 10: Status of vermicompost (Rural garbage) after 4 week (*Pheretima posthuma*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	Nil	6.31	4.48	2.26	195.8kg	472	nil

Table 11: Status of vermicompost (Rural garbage) in 1st day (*Eudrillus euginae*)

Earthworm Species	No. of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	Nil	0.41	0.25	0.22	200kg	nil	nil

Table 12: Status of vermicompost (Rural garbage) after 1 week (*Eudrillus euginae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	Nil	0.42	0.25	0.22	199.0kg	nil	nil

Table 13: Status of vermicompost (Rural garbage) after 2 week (*Eudrillus euginae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	Nil	2.57	1.10	0.89	197.8kg	nil	nil

Table 14: Status of vermicompost (Rural garbage) after 3 week (*Eudrillus euginae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	467	4.11	3.29	2.42	195.3kg	81	467

Table 15: Status of vermicompost (Rural garbage) after 4 week (*Eudrillus euginae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	nil	10.05	5.98	4.37	194.0kg	545	nil

Table 16: Status of vermicompost (Urban garbage) in 1st day (*Eisenia foetidae*)

Earthworm Species	No. of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	nil	0.45	0.18	0.16	200kg	nil	nil

Table 17: Status of vermicompost (Urban garbage) after 1 week (*Eisenia foetidae*)

Earthworm Species	No. of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	nil	0.46	0.18	0.16	199.25kg	nil	nil

Table 18: Status of vermicompost (Urban garbage) after 2 week (*Eisenia foetidae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	nil	2.99	1.03	0.78	198.5kg	nil	nil

Table 19: Status of vermicompost (Urban garbage) after 3 week (*Eisenia foetidae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	501	5.04	3.10	2.18	196.70kg	130	501

Table 20: Status of vermicompost (Urban garbage) after 4 week (*Eisenia foetidae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eisenia foetidae	100	nil	14.08	5.10	4.45	195.8kg	625	0

Table 21: Status of vermicompost (Urban garbage) in 1st day (*Pheretima posthuma*)

Earthworm Species	No. of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	nil				200kg	nil	nil

Table 22: Status of vermicompost (Urban garbage) after 1 week (*Pheretima posthuma*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	nil				199.6kg	nil	nil

Table 23: Status of vermicompost (Urban garbage) after 2 week (*Pheretima posthuma*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	nil				199.15kg	nil	nil

Table 24: Status of vermicompost (Urban garbage) after 3 week (*Pheretima posthuma*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	411				197.7kg	62	411

Table 25: Status of vermicompost (Urban garbage) after 4 week (*Pheretima posthuma*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Pheretima posthuma	100	nil				195.8kg	472	nil

Table 26: Status of vermicompost (Urban garbage) in 1st day (*Eudrillus euginae*)

Earthworm Species	No. of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	nil				200kg	nil	nil

Table 27: Status of vermicompost (Urban garbage) after 1 week (*Eudrillus euginae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	nil				199.0kg	nil	nil

Table 28: Status of vermicompost (Urban garbage) after 2 week (*Eudrillus euginae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	nil				197.8kg	nil	nil

Table 29: Status of vermicompost (Urban garbage) after 3 week (*Eudrillus euginae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	467				195.3kg	81	467

Table 30: Status of vermicompost (Urban garbage) after 4 week (*Eudrillus euginae*)

Earthworm Species	No.of Worms	No of cocoons	NPK %			Compost quantity	Increase/Decrease	
			N	P	K		Worms	Cocoons
Eudrillus euginae	100	nil				194.0kg	545	nil

Discussion

It has been observed that remarkable NPK quantity were available in vermin-vats after three weeks of experiment. Maximum earth-worm population were present in vat nos. 5,10&25, 15, 20 and 30 where earth-worm population were 625, 472, 515, 625 and 545 respectively amongst all those 30 tables. Same numbers of earth-worm were noted in both the vats nos. 10 and 25 which were treated with *Pheritima posthuma*. Simaltaneously, vat nos. 5 and 30 were also treated with same earth-worm species i.e. *Eisenia foetidae.* Table 15 and 30 indicated that in both the cases *Eudrillus euginae* species were applied for the treatment. *Pheritima posthuma* was found to be less effective in respect of quantity of NPK. But, other two earth-worm species i.e. *Eisenia foetidae* and *Eudrillus euginae*were found to be most effective. Though, the earth-worm population were different *Eudrillus euginae* were lesser than that of *Eisenia foetidae*. But, indeed, the size of *Eisenia foetidae* is smaller than that of *Eudrillus euginae.*

The NPK yields are shown graphically in the Figure(1) supplied.

The beauty of vermicomposting if compared with conventional composting process is that the time span for stabilizing and processing the waste is shortened, even though it does not undergo thermophilic phase of composting. The half-digested material thereafter being processed by earthworm, will later being further decomposed by gut associated microbes and converted into mature i.e. fully neutralized compost, (Dominguéz and Edwards, 2004). Earthworms ingest soil, burrow and excrete casts and urine to the soil. In vermicomposting process, earthworms will ingest the substrate introduced into the reactor. There are few terms that can be found in-describing vermicomposting derived liquids. The common ones are called vermiwash, vermicomposting leachate /vermi-leachate, worm bed leachate and worm tea. The term vermiwash was coined by Ismail, 1997. Leachate is generated along with vermicomposting process commonly referred to as vermicomposting leachate or worm-bed leachate (Gutiérrez-Miceliet al, 2011). Extract from vermicompost is known as vermicompost extract, Pantet al, 2009.

Various substrates were used in the same design by others as the modification. Vermiwash collects the nutrients as well as microorganism present in the drilosphere through water percolation (Ismail, 1997). Earthworm activities Benefits : Earthworm activities and its benefits in vermicomposting process. Vermiwash as liquid fertilizer in agricultural sector use from different types of substrates.Substrate used for agricultural purposes as vermiwash (Tharmarajet al , 2011). High concentration of potassium (K) was determined.

Sugar, grain, fish emulsion, kelp tea, humic acid and other bio-degradable products are often added during the process to further enhance the microbial activity of the end-product, Ingham, 2005. Welke, 2005 reported that compost tea extracted through both aerated and non-aerated method from animal manure showed positive effect on various agri-crops.

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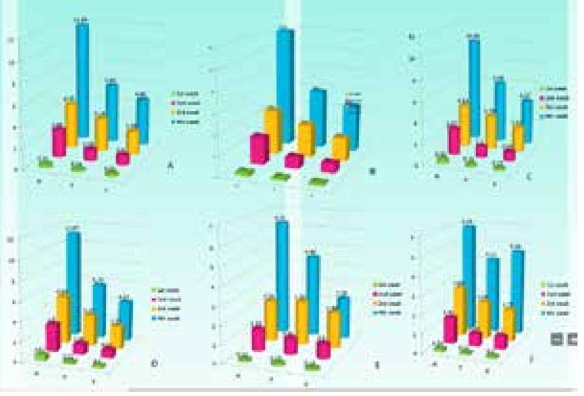

Fig- Vermicompost NPK content after 1,2,3 and 4 weeks for the three species. Rounded Charts for rural and rectangular charts for urban waste medium. a-b-Eisenia foetida c-d-pheretima posthuma e-f-eudrillus euginae

References

1. Brown, G. G., I. Barois, and P. Lavelle.Regulation of soil organic matter dynamics and microbial activity in the drilosphere and the role of interactions with other edaphic functional domains, Eur. J. Soil. Biol. 2000, 36:177-198.
2. Dominguez J. and Edwards C.A. Vermicomposting organic wastes: A review. In: Shakir Hanna SH, Mikhail WZA (eds) Soil Zoology for sustainableDevelopment in the 21st century, Cairo. 2004, pp 369 –395
3. FAO, "Current world fertilizer trends and outlook to 2014." 2010 Rome, Italy.
4. Gutiérrez-Miceli, F. A., R. C. García-Gómez, R. Rincón Rosales, M. Abud-Archila, O. L. María Angela.M. J. G. Cruz and L. Dendooven.Formulation of a liquidfertilizer for sorghum (Sorghum bicolor (L.)Moench) using vermicompost leachate, Bioresource Technology. 2008, 99 (14), 6174-6180.Gutiérrez-Miceliet al, 2011.
5. Ingham, E. R.The compost tea brewing manual; Latest methods and research. Soil Food Web Inc., Corvalis, 2005.
6. Ismail, S.A. Vermicology : The Biology of Earthworms. Orient Longman Ltd, Chennai, India. 1997 92p
7. Jackson, M. L. (1973). Soil Chemical Analysis.Prentice Hall of India Pvt. Ltd.; New Delhi. Pp. 498-404.
8. Jensen, M.H. Controlled environment agriculture in deserts tropics and temperate regions – a world review. Acta Hort. 2002, 578, 19-25.
9. Lavelle, P., G. Melendez, B. Pashanasi and R. Schaefer.Nitrogen mineralization and reorganisation in casts of the geophagous tropical earthworm Pontoscolexcorethrurus (Glossoscolecidae), Biol. Fertil.Soils 1992.14, 49.53.
10. Olsen , S.R., C.V. Cole, F.S. Watanabe and L.A. Dean (1954). Estimation of available phosphorus in soils by extraction with sodium bycarbonate. USDA Circular, 939. U.S Government Printing Office, Washington D.C.
11. Pant, A. P., T.J.K. Radovich, N. V. Hue, S.T. Talcott and K.A. Krenek. Vermicompost extracts influence growth, mineral nutrients, phytonutri-

ents and antioxidantactivity in pakchoi (Brassicarapa cv. Bonsai, Chinensis group) grown under vermicompost and chemical fertilizer. Journal of Science of Food and Agriculture2009 Vol. 89 No. 14 pp. 2383-2392.et al, 2009

12. Scheu,S.Mucus excretion and carbon turnover of endogeic earthworms. Biology and Fertility of Soils 1991, 12: 217-220. 1991.
13. Singh, R. R.K. Gupta, R.T. Patil, R.R. Sharma, R. Asrey, A.Kumar, K.K. Jangra. Sequential foliar application of vermicompost leachates improves marketablefruit yield and quality of strawberry (Fragaria×ananassaDuch.). ScientiaHorticulturae, 2010. 124(1), 34-39
14. Subbiah, B.V. and Asija, G.L.(1956). A rapid procedure for the estimation of available nitrogen in soils.Current Science, 25: 259-260.
15. Tharmaraj, K.,Ganesh P. and Kolanjinathan K., Suresh Kumar R, Anandan A. Influence of vermicompost and vermiwash on physic chemical properties of ricecultivated soil. Current Botany 2011.Vol 2: 18-21.
16. Welke, S. E. The effect of compost extract on yield of strawberries and severity of Botrytis cinerea. Journal of Sustainable Agriculture 2005, 25 57-68.