International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 8, Issue 54, 2016, pp.-2935-2938.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

INFLUENCE OF ANIMAL FECAL ON THE EFFICIENCY OF EARTHWORMS TO CONVERT INTO VERMICOMPOST UNDER DIFFERENT PARTIAL DECOMPOSITION PERIODS

BAGHEL S.S.[1]*, SACHIDANAND B.[2], MISHRA U.S.[3] AND AGARWAL S.B.[4]

[1,2]Department of Soil Science & Agricultural Chemistry, Jawaharlal Nehru Krishi Vishwa Vidyalya, Jabalpur, 482004, Madhya Pradesh, India
[3]College of Agriculture, Mahatma Gandhi Chitrakoot Gramoday Vishwavidyalaya, Chitrakoot, Satna, 485334, Madhya Pradesh, India
[4]ICAR - Krishi Vigyan Kendra, Jabalpur, Madhya Pradesh, India
*Corresponding Author: Email-drssb75@gmail.com

Received: September 22, 2016; Revised: October 19, 2016; Accepted: October 20, 2016; Published: November 06, 2016

Abstract- In India about 700 million tones of organic waste is generated annually apart from goatry, pigry farms. There are growing realizations that the sustainable farming practice can only reverse the declining trend in the global productivity as well as environmental protection. Keeping the above points in view, the present study was carried out to assess the potential of earthworms to convert various animal fecal into vermicompost under different partial decomposition period. The experiment was conducted at Live Stock farm JNKVV, Jabalpur. A total of fifteen treatment combinations including five animal fecal ((Cow, buffalo, goat, horse and pig) and three partial decomposition periods (20, 30 and 40 days) were tried in a RBD design with three replications. Results of study reveal that the pig fecal loosed the maximum weight of 24.11% where as it were lowest in goat excreta. Moreover, the significantly lower duration (42 days) taken up by pig and cow fecal followed by buffalo (43 days). The maximum rate of conversion 192.77 g/day and recovery percent of 68.11 % were recorded under cow and horse dung, respectively. Partial decomposition periods of 40 days recorded the maximum reduction of dry weight of excreta .The increasing duration of partial decomposition increased the rate of conversion and recovery percentage. The conversion of wastes into vermicompost increased the content of macro and micronutrients. The vermicompost of pig fecal excreta proved significantly rich in N, P and K content.

Keywords- Animal fecal, Vermicompost, Partial Decomposition periods

Citation: Baghel S.S., et al., (2016) Influence of Animal Fecal on the Efficiency of Earthworms to Convert into Vermicompost under Different Partial Decomposition Periods. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 54, pp.-2935-2938.

Academic Editor / Reviewer: Dr G.D. Sharma, Gopal Singh Tagore, Dwivedi B.S.

Introduction

Environmental degradation is a major threat confronting the world and the rampant use of chemical fertilizers in agriculture contributes largely to the deterioration of environment through depletion of fossil fuels, generation of carbon dioxide (CO_2) and contamination of water resources. It also leads to words the losses of soil fertility due to imbalance use of nutrients that has adversely affect agricultural productivity and causes soil degradation. Now, there is a growing realization that the use of natural means for sustainable farming practice can only reverse the declining trend in the global productivity as well as environmental deterioration [1]. On the other hand, nearly 700 million tones of organic waste is generated annually from cities and rural areas, which is either burned or used as land filled [2]. Besides, this large quantity of animal waste also generated from Dairy, Goatry, Horse and Pigry farms. These degradable organic wastes when dumped in a open space undergoes either aerobic or anaerobic degradation. These un-engineered dump sites permit fine organic matter to become mixed with percolating water from leachate. The extent of this leachate to pollute adjoining water and soil is high. In India where a lot of solid organic waste is available in different farms with no dearth of manpower, the environmentally acceptable vermicomposting technology using earthworms can very well be adopted for converting waste into wealth. Considerable work has been carried out on vermicomposting of various organization and it has been established that detritivorous and surface dualler earthworms can hasten the composting process to a significant extent with production of a better quality of composts as compared with those prepared through traditional methods. The viability of using earthworms as a treatment or management technique for numerous animal waste streams has been investigated by a number of works [3]. Keeping the above points in view, the present study was carried out.

Materials and Methods

A pot experiments were conducted at live stock research farm JNKVV, Jabalpur during 2013-14 and 2014-15. The objectives to assess the influence of animal fecal on the efficiency of earthworms to convert it in to vermicompost under different partial decomposition periods. For this purpose, fecals of cow, buffalo, goat, horse and pig were collected from the Livestock Farm, JNKVV, Jabalpur. Since collected fresh excreta contain various proportions of moisture, hence, to determine the dry matter content, 100 gram sample were taken from each fecal and allowed to sun dry followed by oven drying till get the constant weight. The various animal fecal (Cow, buffalo, goat, horse and pig) used in study contained 16, 15, 33.8, 27.4 and 25.8 percent dry matter, respectively. Based on dry matter contents for 12 kg of dry matter quantity of various fresh wastes were taken 75, 80, 33.5, 43.8 and 46.5 kg. of cow, buffalo, goat, horse and pig, respectively. The pots were filled with given quantities of variousa excreta and allowed for partial decomposition as per the treatments. Partially decomposed substrata were inoculated with 250 g clitellates (*Eisenia fetida*) and was replicated thrice. Observations with respect to change in temperature and pH of substrata during partial decomposition and vermi stabilization after release of earthworms. Duration

of complete bio conversion, recovery percent of vermicompost content of different nutrients in partially decomposed matter and quantity of vermicompost obtained were recorded.

Results and Discussion

Changes in pH of substrata

The range of pH reduced by allowing all the five animal wastes under aerobic decomposition for different days [Table-1]. The initial pH of fresh fecals of cow, buffalo, goat horse and pig were (6.78, 6.79, 7.43, 7.03 and 7.12) respectively, which declined with the start of aerobic pre decomposition process and reached nearly neutral limit in all, except fecal of goat. Thus, it is a suitable condition to release of earthworms in substrata after 20 days of partial decomposition. However, pH of goat excreta was in alkaline range at 20 days periods of partial decomposition. Thus, 30 days of partial decomposition was found suitable for release of earthworms in goat excreta. These results are also corroborated the findings of [4-5].

Table-1 *Changes in pH of various animal fecal during partial decomposition*

Animal fecal	Partial Decomposition Periods (days)			Mean
	20	30	40	
F_1	6.78	6.67	6.64	6.69
F_2	6.79	6.75	6.69	6.74
F_3	7.43	7.04	6.93	7.13
F_4	7.03	6.87	6.85	6.91
F_5	7.12	6.81	6.73	6.88
Mean	7.03	6.82	6.76	
	Fecal (F)	Partial Decomposition period (P)		FxP
SEm±	0.09	0.05		0.17
CD at (5%)	0.28	0.15		NS

Changes in temperature of substrata

Initial temperature of cow, buffalo, goat, horse and pig fecals recorded the 30.5, 31.8, 40.6, 30.9 and 30.4^{0}C respectively, [Table-1]. The survival, multiplication as well as activities of earthworms were not appreciable due the rise in temperature above to 25 ^{0}C. It means a fresh goat excreta is unfit to release of earthworms for vermicomposting even after 40 days of aerobic decomposition. It was further noted that temperature of all substrata raised up to a limit (up to 40.6^0 C) at 20 days after pre decomposition period of goat fecal, while it was around 30^0 C in substrata of cow, buffalo, horse dung and pig fecal. Thus, earthworms would not able to do well, if they are released for vermicomposting after 20 days of partial decomposition in almost in all substrata. It was further noted that temperature exhibited declining trend in cow, buffalo, horse and pig fecal after 20 days. Hence, there would not be much risk, if earthworms released at 30 days of partial decomposition. However, the higher temperature was recorded (More than 30^0 C) in goat excreta after allowing them to partial decomposition for 30 days or even 40 days. Through, the temperature showed declining trend. Thus, the earthworm species *Eisenia fetiada* (More tolerant to temperature fluctuations) could be released for vermicomposting after 40 days periods of partial decomposition in goat excreta. Similar results have been reported by [6-7].

Table-2 *Changes in temperature (^{0}C) of different type of animal fecal during partial decomposition*

Animal fecal	Partial Decomposition period (days)			Mean
	20	30	40	
F_1	30.5	26.4	24.8	27.23
F_2	30.8	26.7	24.9	27.46
F_3	40.6	38.9	35.9	38.46
F_4	30.9	28.8	26.3	28.66
F_5	30.4	29.1	25.4	28.30
Mean	32.64	29.98	27.46	
	Fecal (F)	Partial decomposition period (P)		FxP
SEm±	2.26	1.68		3.93
CD at (5%)	6.80	5.04		11.85

Effect of animal fecal

It reveled from the [Table-3] that partially decomposed animal fecal for different period of time accepted by worms differently. Further, it was observed that during partial decomposition, the reduction in weight substrata was noted from 16.16 to 24.11 per cent. Under different treatments. The maximum percent reduction in weight (24.11%) was recorded in pig, where as the least reduction was in goat fecal. More-over, different type of fecal took 42 to 75 days to convert into vermicompost. The excreta of pig, cow, and buffalo complete the process almost all in 42-43 days. The goat excreta require higher duration of 75 days to complete the process. On the other hand, significantly higher rate of conversion (192.77 g/day) and recovery of 68. 87% were recorded under cow dung, respectively. However, it was at par to other except goat fecal, which had only 76.83 g/day conversion rate and percent 47.57 recovery.

Effect of Partial decomposition

The partial decomposition period lossed the weight by 13.89, 23.18 and 27.38% during 20, 30 and 40 days, respectively.

Table-3 *Dry matter content reduction at different stages and conversion rate of different excreta in to vermicompost*

Treatments Animal Fecal	Dry weight of substrata (Kg) (At initial)	Dry weight of substrata (Kg) (After Partial decomp.)	Per-cent reduction in dry weight	Duration for bioconversion (after worm inoculation)	Conversion rate (g/day)	Recovery percent
Cow dung	12	9.30	22.44	42	192.77	66.87
Buffalo dung	12	9.27	22.74	43	183.62	65.57
Goat excreta	12	10.06	16.16	75	76.82	47.57
Horse dung	12	9.36	21.96	47	177.26	60.77
Pig excreta	12	9.10	24.11	42	182.72	63.94
CD at (5%)	-	0.75		6.15	15.90	
Pre inculcation decomposition of substrata (Days) Period (Days)						
20	-	10.33	13.89	53.8	146.95	59.09
30	-	9.25	23.18	50.0	156.14	61.44
40	-	8.71	27.38	45.6	184.82	67.09
CD at 5%	-	0.96	-	6.93	18.85	-

The partial decomposition period showed marked variation with respect to complete bio conversion of waste into vermicompost and also increase the rate of conversion and recovery percentage. The rate of conversion (rate g/day) and percent recovery increase with increasing duration of partial decomposition periods. The each incremental period of partial decomposition of ten days, reduced about 5 days in duration of complete conversion. The maximum rate of conversion (184.82 g/day) and recovery percent of 67.09% was recorded under 40 days where as it was lowest (146.95 g/day and 59.09%) respectively, under 20 days.

The content of N, P, K, Zn, Cu, Fe, and Mn was determined in fresh substrata, partially decomposed matter of different of periods and in finally prepared vermicomposts. It is obvious from the data that fresh cow dung was rich in Fe

content while fresh pig fecal contained maximum concentration of N, P, K, Zn, Cu and Mn [Table-4]. The chemical composition of feed and fodder made available to these animals and their digestive system may cause the variation in the nutrients. Similar findings were reported by [8].

The content of N, P and K increased in partially decomposed matter as well as in vermicompost over the undecomposed fresh substrata. The pig excreta proved significantly rich in N, P and K content at both the stages (partially decomposed and finally prepared vermicompost) closely followed by goat fecal. The difference in content of nitrogen, phosphorus and potassium in various animal excreta and its vermicompost might be attributed to the differences in chemical composition of concentrates and roughes animals as feed. The increase in content of N, P and K in vermicompost due to the breakdown of substratal intake in the gut of earthworm. In the presence of micro-flora. The muscular gizzard of earthworm accelerated the degree of polymerization of humic substances, which increased the nitrate nitrogen [9]. These findings are in close conformity with the findings of [10]. The increase in phosphorus content in vermicompost over partially decomposed matter might be due to the mineralization and mobilization of phosphorus by bacterial and fecal phosphate activity of earthworms. Similar findings were reported by [11-12].

Table-4 *Content of N, P, K, Zn, Cu, Fe and Mn in partially decomposed matter and vermicompost*

Treatment Animal fecal	N (%)		P (%)		K (%)		Fe (ppm)		Zn (ppm)		Cu (ppm)		Mn (ppm)	
	Partialy decomposed	Vermi compost	Partialy decomposed	Vermi compost	Partialy decomposed	Vermi compost	Partialy decomposed	Vermi compost	Partialy decomposed	Vermi compost	Partialy decomposed	Vermi compost	Partialy decomposed	Vermi compost
Cow	0.81 (0.43)	1.18	0.47 (0.33)	0.69	0.53 (0.39)	0.85	670 (457)	729	38 (20)	60	19 (8)	26	285 (108)	295
Buffalo	0.79 (0.41)	1.16	0.44 (0.32)	0.66	0.51 (0.38)	0.83	667 (449)	725	34 (20)	60	18 (8)	26	283 (119)	298
Goat	0.72 (0.55)	1.20	0.42 (0.31)	0.76	0.68 (0.43)	0.99	597 (281)	691	40 (23)	57	21 (10)	27	297 (102)	302
Horse	0.63 (0.35)	1.10	0.38 (0.38)	0.69	0.66 (0.40)	0.97	619 (390)	780	39 (19)	68	15 (06)	23	280 (115)	293
Pig	0.98 (0.49)	1.64	0.58 (0.39)	0.88	0.88 (0.66)	1.02	713 (417)	825	47 (28)	68	24 (12)	29	305 (122)	315
SEM +_	0.02	0.03	0.016	0.026	0.009	0.012	16.18	21.20	1.08	2.31	0.39	0.58	1.81	2.58
CD at 5%	0.06	0.09	0.049	0.08	0.029	0.036	48.60	63.68	3.24	6.95	1.17	1.75	5.43	7.74
Partial decomposition periods(Days)														
20	0.68	1.05	0.35	0.62	0.52	0.71	630.0	718.20	31.20	56.40	15.40	20.60	278.60	286.40
30	0.77	1.27	0.46	0.74	0.64	0.98	658.6	753.80	41.20	63.80	18.80	27.20	290.20	302.80
40	0.90	1.44	0.55	0.83	0.74	1.09	671.0	763.00	45.80	70.60	22.80	30.80	301.20	312.60
SEM+_	0.037	0.036	0.031	0.049	0.062	0.074	5.93	6.81	2.93	3.37	1.11	2.09	2.15	2.95
CD at 5%	0.11	0.17	0.10	0.14	0.186	0.23	17.79	20.43	8.79	11.19	3.33	6.27	6.46	8.85

Note: Figures in parenthesis are chemical composition of undecomposed fecal.

The increase in K content was observed during partial decomposition over fresh excreta. This is attributed to the breakdown of excreta due to the attack of decomposer microbes, which were proliferated in animal excreted matter [13]. The increase in content of potassium in vermicompost over partially decomposed matter might be due to the grinding action of muscular gizzards and further utilization of grinded matter by the microbes as food brought out some chemical changes, which increased the content of potassium.

Conclusion

Data in relation to Fe content in substrata after partial decomposition and finally prepared vermicompost are given in [Table-4]. The animal fecal used for vermicomposting varied for their Fe content. Cow dung was the richest in Fe (457 ppm) followed by buffalo (449 ppm), pig (417ppm), horse (390ppm) and goat fecal (281ppm). The Fe-content remarkably increased in all substrata when they were subjected to partial decomposition and finally convert into vermi compost. The values were quite higher over previous stage. These animal excreta ranked in the order of Pig fecal >Cow > Buffalo > Horse > Goat fecal at partial decomposition and Pig fecal >Horse >Cow > Buffalo > and Goat fecal in final vermicomposts. The other micronutrients *viz.* Zn, Cu and Mn were fined different in fresh animal excreta used for vermicomposting. Pig fecal proved to be the richest in Zn (28 ppm) Cu (12 ppm) Mn (122 ppm) followed by goat fecal (23, 10, 102 ppm for Zn, Cu and Mn, respectively). These nutrient content increased markedly by allowing for partial decomposition and subsequently release of earthworms for converting into vermicompost. The composition of Zn, Cu and Mn in vermicompost fecal of Pig (68, 29, 315 ppm), Goat (57, 27, 302 ppm), Horse (68, 23, 293 ppm), Buffalo (60, 26, 298 ppm) and Cow (60, 26, 295 ppm), respectively. The concentration of Fe, Zn, Cu and Mn content increased at the end of partial decomposition of all substrata over the status in fresh substrata. The concentration of these nutrients also corresponding increased with the advance of period for partial decomposition from 20-30 days. The concentration of all these nutrients also increased in final product i.e. vermicompost. It is remarkable that the vermicompost prepared from different substrata showed increasing trend of nutrient concentration due to increasing periods of partial decomposition as 20, 30 and 40 days, but variations were significantly noted only between 20 and 40 days. The finding pertaining to chemical composition of vermicompost prepared from various animal wastes are management with those of [14-16].

Conflict of Interest: None declared

References

[1] Wani S.P., Rupela O.P. and Lee K.K. (1995) *Plant and Soil,* 174, 29-49.

[2] Bhiday M.R. (1994) *Indian Farming,* 43 (10), 31-34

[3] Singh A and Sharma S. (2000) *Bioresource Technology*, 85, 107-11.

[4] Thang C. M. (2003) *National Institute of Animal Husbandry* Hanoi Vietnam Thang@mekarn.org

[5] Gupta P.K. (2004) Vermicomposting materials in vermicomposting for sustainable agriculture, pp. 48.

[6] Pallaniappan S.P. and Annadurai K. (2003) Organic farming: Theory and practices, pp. 74-97.

[7] Loh T. C., Lee Y.C., Liang J.B. and Tan D. (2004) *Biores.Tech.,* 96,11 – 114.

[8] Meshram T. (2007) *M.Sc. Thesis* JNKVV, Jabalpur

[9] Cegarra J, Famandez FM, Terccro A and Roig A (1992) Preliminary result. Mitteilungen-aus-dem-HamburgischenZoologischen–Muscum-und-Institute, 89 (2), 159-67.

[10] Bohlen L.P. and Edwards C.A. (1995) *Soil Biology and Biochemistry*, 27(3), 341-348.

[11] Edwards C.A and Lofty J.R. (1972) *Biology of earthworms.* Chapman and Hall, London.

[12] Garg V.K., Yadav Y.K., Aleenjeet S., Leoran Subhash Chand and Kaushik

Priya (2006) *PP Environmentalist*, 26, 269-276.
[13] Ganguly T.K., Singh A.B. and Manna M.C. (2004) Management of organic wastes for crop production by ICAR, New Delhi, pp. 18-22.
[14] Katyal J. C. (1993) In : Proceeding India National Science Academy, B. 59 (3&4), 161 – 161.
[15] Manna M.C.,T.K. Ganguly and Ghosh B. N. (2000) *Journal of the Indian Society of Soil Science,* 48,781-786.
[16] Khan A.G.(1993) *Poultry pounch.*, 9 (3), 41-44.