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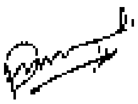
Editorial Note

CSIBER International Journal of Environment (CIJE) offers a venue where relevant interdisciplinary research, practice and case studies are recognized and evaluated. Increasingly, environmental sciences and management integrate many different scientific and professional disciplines. Thus the journal seeks to set a rigorous, credible standard for specifically interdisciplinary environmental research. CIJE is a multidisciplinary journal, publishing research on the pollution taking place in the world due to anthropogenic activities. CIJE welcomes submissions that explore environmental changes and their cause across the following disciplines like atmosphere and climate, biogeochemical dynamics, ecosystem restoration, environmental science, environmental economics & management, environmental informatics, remote sensing, environmental policy & governance, environmental systems engineering, freshwater science, interdisciplinary climate studies, land use dynamics, social-ecological urban systems, soil processes, toxicology, pollution and the environment, water and wastewater management, etc.

We invite authors to contribute original high-quality research on recent advancements and practices in Environment Management. We encourage theoretical, experimental (in the field or in the lab), and empirical contributions. The journal will continue to promote knowledge and publish outstanding quality of research so that everyone can benefit from it.

Er. D. S. Mali
Editor, CIJE



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Evaluation of Nutrient Content of Vermicompost and its Applications

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Abstract

In this research biodegradable waste like cow dung, buffalo dung, Goat dung sugarcane trash were collected in that vermicomposting process using earthworms like eisenai fadita. After the collection of waste material kept degrading for 90 days. After degradation, the physicochemical characteristics were analysed and from the result, it is required the waste material was converted into vermicomposting. Vermicomposting is a biological technique of converting organic wastes into a rich soil amendment. In this paper, a thorough literature is done regarding the impacting factors for a vermicomposting unit followed by the design of a pit for vermicomposting and the number of earthworms required for the obtained amount of waste. This is further continued by selecting the optimum range for parameters such as Temperature, Potential Hydrogen, and TAN.

Key words: Vermicomposting, vermicompost, Eisenaifadita, Biodegradable.

Introduction

Vermicomposting is the excreta of earthworms which are capable of improving soil health and nutrient status. Vermiculture is a process by which all types of biodegradable waste are converted while passing through the worm gut to nutrient-rich vermicompost. Vermi Worms are used here to act as biological agents to consume that waste and to deposit excreta in the process called vermicompost.

In that vermicompost 84 bacteria’s are present and that way they are used in soil like plant growth promoters’ like auxins, gibberellins, cytokinins, and beneficial microbes not only improve the growth and yield of crops but also increase the diversity and activate antagonistic microbes and nematodes, which help to suppress pests and diseases caused by soil-borne phytopathogens.

Heavy use of agrochemicals since the “Green Revolution" of the 1960s boosted food productivity at the cost of the environment & society destroyed their natural fertility, and impaired the power of Biological Resistance in crops making them more susceptible all over the world desperately looking for an economically viable, socially safe environmentally sustainable alternative to the agrochemicals. In this research biodegradable waste like Cow dunk, Goat dunk, Buffalo dunk, and Sugarcane trash was collected in that vermicomposting process using earthworms like Eisenia fajita. After completing the vermicomposting process, this research compares the nutrient values like OC, OM, N, P, and K in the different vermicomposting samples and applied to the sugarcane plant as a basal dose.

Literature Review

A brief review of the past studies related to vermicompost analysis and application.
Sujit Adhikary *et al* (2012) in their article Vermicompost, the Story of Organic Gold says that Earthworms have been studied by philosophers like Pascal and Thoreau, but their role in agricultural nutrition has only gained attention in recent decades. Waste management is crucial for a sustainable society, and vermicomposting is an alternative method. Earthworm excreta (vermicast) is a nutritive organic fertilizer rich in micronutrients, beneficial soil microbes, and growth hormones. Vermicompost and its body liquid (vermiwash) are proven growth promoters and protectors for crop plants.

Chaudhary D.R. Bhandari S.C. 1, Shukla L.M. *et al* (2004) in their article Role of vermicompost in sustainable Agriculture say that Organic waste returned to the soil can improve soil quality, fertility, and productivity. Vermicompost technology reduces decomposition time and produces high-quality compost. Its crucial for integrated plant nutrient supply systems, maintaining soil health, and reducing crops are also highlighted in the article, Vermicompost can be used as a potting mixture for horticulture crops.

Manuel Blouin, Nicolas Meyer, Silene Lartigue, *et al* (2019) in their article Vermicompost significantly affects plant growth they say. A meta-analysis says that The growing world population presents a double challenge in food production and waste management. Recycling organic residues into compost for food production could help address this issue. A meta-analysis of studies on vermicomposting found that it increased commercial yield, total biomass, shoot biomass, and root biomass by 26%. The positive effect was strongest when vermicompost represented 30-50% of soil volume. Cattle manure was the best material for vermicompost production. Herbs and legumes showed the largest biomass increase. The study recommends authors provide minimum statistics for meta-analyses

Usman Ali, Nida Sajid, Azeem Khalid, Luqman Riaz, *et al* (2015) in their article A review on vermicomposting of organic wastes says that the review discusses the potential of vermicomposting as an eco-friendly solution for handling global solid waste. It highlights the integration of composting and vermicomposting processes, optimizing the conversion of organic waste by microorganisms and earthworms under controlled conditions. The nutrient-rich compost produced can be used for biogas production, enabling efficient waste management and energy production.

Addison Lynch, *et al* (2002) in their article Vermiculite: A Review of the Mineralogy and Health Effects of Vermiculite Exploitation say that vermiculite, a mica mineral used in insulation, composite cement, and horticulture has no serious health risks due to its long-term chemical durability. However, if a significant amount of asbestos is present, it could pose a health risk. Regulation prevents inadvertent exposure to asbestos in vermiculites, but caution is needed to accurately identify asbestos hazards. Test methods and action levels are recommended for asbestos in vermiculites and other raw materials.

Su Lin Lim, Ta Yeong Wu *et al* (2014) in their article The use of vermicompost in organic farming: an overview of, effect on soil and economics say that vermicomposting, a process using earthworms to convert organic materials into humus, has been found to improve soil fertility physically, chemically, and biologically. It enhances aeration, porosity, bulk density, water retention, pH, electrical conductivity, and organic matter content, leading to better crop yield. However, a high concentration of soluble salts in vermicompost can impede the growth of vermicompost, It is an important benefit in agriculture, so it should be applied at a moderate concentration for maximum plant yield.

Olle Margit *et al* (2019) in their article Vermicomposts Its Importance and Benefit in Agriculture say that vermicomposting is a process of bio oxidizing and stabilizing organic material using earthworms and microorganisms under suitable conditions warms reduce waste volume by 40-60%. This process produces rich, nutritious vermicompost, which reduces west usage, pest attacks, and weed growth. It also boosts horticulture production without agrochemicals. Despite its benefits, vermicompost uses are not widespread yet, and this review aims to increase awareness of this local soil amendment.

Vasanthi D. Kumaraswamy K. *et al* (2016) in their article Efficacy of vermicompost to improve soil fertility and rice yield says that field experiments were conducted at the agriculture college and research institute Madurai to evaluate the effectiveness of vermicompost made from various organic materials to increase rice yield and soil fertility. The experiment showed that treatment with vermicompost plus nitrogen, phosphorus, and potassium at the recommended level resulted in higher grain yields, higher organic carbon content, higher fertility status, micronutrients, and lower bulk density. The result also indicated that vermicompost was sufficient for rice crop application when applied with the recommended level of NPK

Jorge Santigo-Borraz *et al* (2006) in their article Vermicompost as a soil supplement to improve growth, yield and fruit quality of Tomato says that A greenhouse experiment investigated the impact of earthworm–processed sheep- manure on tomato growth, productivity, and chemical characteristics. Five treatments were applied, with growth and yield parameters measured 85 & 100 days after transplantation Vermicompost increased plant height but had no effect on leaf numbers or yield. Yields were greater when vermicompost soil ratio was 1:1,1:2, or 1:3,100 days after transplantation. vermicompost also decreased soil p^H and increased soluble and insoluble in tomato

S.Manivannan, M.Balamurugnl *et al* (2007) in their article Effect of vermicompost on soil fertility and crop productivity –beans say that The study conducted in Sivapuri, Chidambaram, Tamil Nadu, compared the efficacy of vermicompost compared to inorganic fertilizers (NPK) on soil characteristics and bean growth. The result shows that vermicompost significantly improved pore space, water-holding capacity, cation exchange capacity, particle reduction,bulk density, pH, electric conductivity, and Organic carbon. Inorganic fertilizers reduced porosity organic carbon and microbial activity in both soil types.

Methodology

Available Nitrogen in vermicompost

A given weight of vermicompost is treated with an excess of alkaline $KMnO_4$ and Distilled.$KMnO_4$ is a mild oxidizing agent in an alkaline medium. The organic matter present in the vermicompost is oxidized by nascent oxygen liberated by $KMnO_4$ in the presence of NaOH and thus the ammonia released is distilled and absorbed in a known volume of standard acid. The excess of which was titrated with a standard alkali using methyl red as an indicator. Nitrogen estimated by this method is considered as potentially available nitrogen

Procedure

Distillation

Assemble the distillation assembly.

1. Take 1 gm. of vermicompost in a Kjeldahl distillation flask.
2. Add 20 ml of Distilled water and 100 ml of 0.32 % $KMnO_4$ solution.
3. By using a volumetric flask take 25 ml 0.02N H_2SO_4 in the conical flask.
4. Add 2-3 drops of methyl red indicator and dip the end of the delivery tube into it.
5. Pour 100 ml of 2.5% NaOH into the Kjeldahl distillation flask and cork it immediately.
6. Distill the Ammonia gas from the distillation flask and collect it in H_2SO_4 solution.
7. Continue distillation till the evolution of ammonia stops completely (Test it by bringing moist red litmus paper near the outlet at the condenser which will turn blue as long as ammonia is being evolved).
8. Collect distilled ammonia gas into 0.02 N H_2SO_4 in a conical flask (Approx.150ml).
9. Titrate the distillate with 0.02N NaOH – End point – Pink to Yellow.

Available Phosphorus in vermicompost

Principle

In this method, vermicompost is shaken with 0.5M NaHCO3 solution in a 1:20 ratio for half an hour in the presence of activated charcoal, and the extract is obtained by filtering the suspension. Phosphorous in the extract is treated with Ammonium Molybdate and then $SnCl_2$ reagent, which results in the formation of the blue-colored complex. The intensity of the blue color formed is directly proportional to the quantity of phosphorus entering the reaction. So phosphorus in the extract can be determined spectro-photometrically.

Procedure

A. Extraction

1. Weight 1gm of vermicompost sample in 100ml conical flask.
2. Add a pinch of activated charcoal and 20 ml of 0.5m NaHCO3 solution.
3. Shake the contents of the flask for half an hour and filter the suspension through man filter paper No.01.
4. Prepare the blank with the entire reagent.

Analytical Determination

1. Prepare a series of phosphorous concentrations in the range of 0 to 1 ppm by pipetting out 0(blank), 2,4,6,8, and 10 ml of 2 ppm of Phosphorus working standard and diluting them to 25 ml.
2. Pipette out 5 ml of extract in a 25 ml volumetric flask and dilute it to 25ml.
3. To all these solutions add 2 ml of Ammonium Molybdate Reagents and 1ml of freshly prepared $SnCl_2$.
4. Exactly after 10 min measure the absorbance at 680 nm.
5. Prepare a standard graph for phosphorus (On the X axis take a concentration of P in ppm and on the Y axis take the Absorbance reading)
6. Locate the sample reading on the standard graph and calculate the results.

Available potassium in vermicomposting Principle

The method is based on the principle of equilibrium of soil, an exchange action made of the solution of Neutral normal NH4OAc in a given soil: solution ratio, during the equilibrium, ammonium ions exchange with the exchangeable **K** ions of the soil. The K contention of the equilibrium solution is estimated with a flame photometer. Since NH_{4+} holds highly charged layers together just like K, the release of the fixed K, in an exchangeable form, is retained during NH_4OAc extraction.

Procedure

1. Weight 5ml soil in 150ml conical flask.
2. Add to it 25ml of neutral NH_4OAc solution and a pinch of Activated charcoal.
3. Shake the contents of the conical flask on a shaker for 5 minutes and filter through Whatman No.1 filter paper
4. Feed the filtrate into the atomizer of the flame photometer and note down the reading
5. Prepare a set of working standards as shown in the table below and take reading
6. Plot the graph inciting concentration on the X axis and Readings on the Y axis for determination of concentration of K.

Organic Carbon and Organic Matter Content of Vermicompost

Principle:

A weight of vermicompost sample is treated with an excess volume of standard $K_2Cr_2O_7$ in the presence of concentrated H_2SO_4. The vermicompost is slowly digested at the low temperature by the heat of dilution H_2SO_4 and the organic carbon in the vermicompost is oxidized to Co_2. The highest temperature obtained by the heat of dilution reaction produced on the Addition of H_2SO_4 is approximately 120 ^{0}c, which is sufficient to oxidize the active forms of soil organic carbon, but not the mere complex organic form of carbon that may be present. The excess of $K_2Cr_2O_7$ not reduced by the organic matter is titrated back against a standard solution of ferrous Ammonium Sulfate, in the presence of Phosphoric acid and diphenylamine indicator.

Procedure:

1. Take 1gm of vermicompost in a 500ml capacity conical flask.
2. Add 10 ml of 1N $K_2Cr_2O_7$ and shake for some time.
3. Add 20 ml Conc. H_2SO_4 swirl for 2-3 times and stand for 30 min.
4. Add 200 ml of water, and filter if the solution is not clear.
5. Add 10 ml of 85 % Phosphoric acid and 1 ml Diphenylamine indicator.
6. Titrate with FAS (0.1 N) the endpoint is a color change from Violet Blue to Bright Green. Similarly, run the blank.

Result and Discussion:

Table 1: Available Nitrogen in vermicompost.

Wt. vermicompost taken	1.000gm
Vol. of 0.02N H_2SO_4 taken	50 ml
Vol. of 0.02N NaOH used (Burette reading)	4.7 ml
Vol. of $0.02H_2SO_4$ used for NH_3 absorption	45.3 ml

Result

Available Nitrogen determined for given vermicompost sample i) buffalo = 1.23 kg/ha

Cow =1.26 kg/ha

Goat = 8.04 kg/ha

Table 2: Available Phosphorus in vermicompost

Sr. No.	(P) Conc	2 ppm 'P' Std (ml)	Total Vol. (ml)	Amm. Molybdate Reagent (ml)	$SnCl_2$ Reagent (2ml)	Abs. at 680nm after 10 min
1	0	0	25	2.0	1	0
2	0.16	2	25	2.0	1	0.05
3	0.32	4	25	2.0	1	0.14
4	0.48	6	25	2.0	1	0.22
5	0.64	8	25	2.0		0.33
6	0.80	10	25	2.0	1	0.39
7	0.96	12	25	2.0	1	0.43
Sample 1 buffalo	1 gm	-	25	2..0	1	0.17
Sample 2 Cow	1 gm	-	25	2.0	1	0.19
Sample 3 Goat	1 gm	-	25	2.0	1	0.18

Result:-

Available phosphorus determined for the given vermicompost sample is

Buffalo=180 ppm

Cow =220 ppm

Goat =200 ppm

Table 3: Available Potassium in vermicompost

Sr. No	Conc Mg/lit	Ml of Std. (100 ppm)	Ml of distilled water	Total volume	Flame photometer Reading
1	0	-	50	50	2
2	5	2.5	47.5	50	20
3	10	5.0	45	50	40
4	15	7.5	43.5	50	60
5	20	10	40	50	80
6	25	12.5	37.5	50	100

Sample 1 Buffalo	5	-	-	50	38
Sample 2 Cow	5	-	-	50	57
Sample 3 Goat	5	-	-	50	79

Result:-

Given vermicompost contains
Buffalo =106.4 kg/ha
Cow =159.6 kg/ha
Gaot =221.2 kg/ha

Table 4: Table 4: Available Nitrogen (N), Phosphorous (P), Potassium (K), Organic Carbon (OC), Organic Matter (OM) in vermicompost.

Sr. No	Avl.'N' in Vermicompo st st in %	Avl. 'P' in vermicomp ost in ppm	Avl. 'K'in vermicompost In kg/ha	OC in vermicompost ost in %	OM in vermicompost in %
Sample 1	1.23	180	106.4	10.47	18.05
Sample 2	1.26	220	159.6	16.29	28.08
Sample 3	8.04	200	221.2	18.99	32.73

Sample1:-Vermicompost sample (buffalo dung +Sugarcane trash)
Sample 2:- Vermicompost sample (Cow dung +Sugarcane trash) Sample 3:- Vermicompost sample (Goat dung +Sugarcane trash)

Applications

In this research, vermicompost is used in sugarcane crops as a basic dose. It provides physical, Chemical, Biological, and micro-biological improvement in the soil it is used. Studies show that amending soil with vermicompost causes germination starting from 7 to 10 days.
In this research, after the use of vermicompost conclusion is the development of sugarcane crop root, and stem size, improves plant growth and height,

Conclusion

This research noticed that vermicompost is environmentally friendly because it is derived from living things, including plants, animals, and manures while inorganic are synthetically derived chemicals plus minerals from the earth. In this research vermicompost is ideal organic manure for better growth and yield of many plants. Vermicompost is best for soil fertility and plant growth.

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