ZIBELINE INTERNATIONAL™ PUBLISHING
ISSN: 2710-6012 (Online)
CODEN: JWBMAO

Journal of Wastes and Biomass Management (JWBM)

DOI: http://doi.org/10.26480/jwbm.02.2022.96.101

CrossMark

RESEARCH ARTICLE

EVALUATION OF NUTRIENT CONTENT OF COMPOSTS MADE FROM WATER HYACINTH, KITCHEN WASTE AND MANURES

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ARTICLE DETAILS

Article History:

Received 29 June 2022
Accepted 04 October 2022
Available online 06 October 2022

ABSTRACT

Though composts are prepared with different agricultural and non-agricultural materials, information on preparation of compost with water hyacinth is limited. An experiment was conducted at the Germplasm Centre of Agrotechnology Discipline of Khulna University of Bangladesh during January to March 2014 to evaluate the nutrient content of composts made from water hyacinth (WH), kitchen waste (KW), cow dung (CD), farmyard manure (FYM), and poultry litter (PL). The experiment was laid out in randomized complete block design (RCBD) with 15 treatments viz. WH, KW, CD, FYM, PL, WH:KW (1:1), WH:CD (1:1), WH:FYM (1:1), WH:PL (1:1), KW:CD (1:1), KW:FYM (1:1), KW:PL (1:1), CD:FYM (1:1), CD:PL (1:1), and FYM:PL (1:1) and three replications. The prepared composts were dark brown to black with earthy smell and large-textured. Cow dung in combination with farmyard manure or poultry litter resulted highest content of total N, S, Zn, and B and farmyard manure and poultry litter had highest content of total P. Again, poultry litter with water hyacinth estimated highest total K. Combination of water hyacinth with farmyard manure had the highest Ca and Mg content. Therefore, combination of composting materials (CD, PL, FYM, WH) resulted better nutrient content of composts rather than using alone. The results suggest use of water hyacinth, an invasive aquatic weed, as a composting material that can improve our soil health.

KEYWORDS

Compost, Water Hyacinth, Kitchen Waste, Cow Dung, Farmyard Manure, Poultry Litter, Nutrient Analysis

1. INTRODUCTION

Compost, the fragile mass of organic matter, usually made from rotten plant material for using in organic agriculture. Compost acts as a soil conditioner that leads to increased nutrient, organic matter, and water-holding capacity of soil and boosted up load, diversity and activity of beneficial soil microbes (Inckel et al., 2005; Insam and de Bertoldi, 2007; Zhen et al., 2014). Compost properties depends on materials used and composting process (Bernal et al., 2009). Compost can be prepared from crop residues, weeds, tree litter, animal manures, poultry litter, human wastes, industrial wastes and municipal wastes. Combination of municipal solid waste (MSW) with mustard oil cake (MOC) and cow dung (CD) at 5:2:3 ratio resulted 2.91 % N, 0.62% P, 0.77% K and 0.45% S and replacing of CD with poultry manure (PM) in the above combination increased nutrient content to 3.14 % N, 0.84% P, 0.84% K and 0.52% S (Sultana et al., 2018).

Compost is a well-decomposed organic material that maintains soil health. Compost improves the soil structure such as better aggregation, pore spacing, and water storage and increases the yield of crop (Petruzzello, 2021). However, soil health is deteriorated over time and is considered as a major threat for world food production. Land degradation, high input cost, unavailability of farm inputs, and climate change confronted the food production worldwide (Pimentel and Burgess, 2013). In fact, the frequent use of chemical fertilizers contributes largely to soil and environmental degradation, loss of soil fertility and productivity, increase production cost and decrease quality of produce (Khan and Ishaq, 2011; Saha et al., 2019). On the contrary, organic matter (CD and PM) alone can produce statistically similar yield of tomato and knolkhol in comparison with recommended dose of N, P, K (Islam et al., 2020; Saha et al., 2019).

Over years, problems associated with the use of hazardous chemicals for crop production and protection, as well as weed control are increasing that requires proper attention due to growing resistance against pests, diseases and weeds worldwide. In such a condition, there has been a growing conviction that compost is the best option available to restore and enhance soil potential in order to attain sustainable soil and crop productivity and thus sustainability (Briggs and Courtney, 1985). Compost can repay the organic matter and nutrients to the soil that enhance soil health and improve crop growth (Sullivan et al., 2018). Composting is an age-old procedure of improved and sustainable agricultural productivity that converts organic wastes into valuable soil amendment and combat soil organic matter decline and soil erosion (Fening et al., 2010; Chiumenti and Chiumenti, 2011; Sarkar and Chourasia, 2017).

However, compost contains low nutrient that releases slowly and there is a potential risk of leaching loss of nutrients. It also requires space, time, and labor to produce compost and a considerable volume of compost is required to produce healthy crops (Taguiling, 2013). Due to low nutrient content, a large amount of compost needs to apply. Composts generally contain 2% N, 0.5-1% P, and 2% K and only 5% of total N in a compost is available for plant (Petruzzello, 2021). Therefore, producing a compost with higher nutrient content would be quite promising for maintaining soil fertility and sustaining agricultural productivity. Reports are available on how to prepare and analyse compost from agricultural and non-agricultural wastes (Karanja et al., 2019; Khaing et al., 2019; Khater, 2015; Mladenov, 2018; Sullivan et al., 2018). However, preparation of composts

Quick Response Code	Access this article online	
	Website: www.jwbm.com.my	**DOI:** 10.26480/jwbm.02.2022.96.101

Cite the Article: Nasrin Sultana, Md. Abdul Mannan, Md. Yamin Kabir (2022). Evaluation of Nutrient Content of Composts Made from Water Hyacinth, Kitchen Waste and Manures. *Journal of Wastes and Biomass Management, 4(2): 96-101.*

from water hyacinth (WH), kitchen waste (KW), cow dung (CD), farmyard manure (FYM), and poultry litter (PL) along with their all-possible equal (1:1) combinations (between any two) and their nutrient contents are not evaluated yet. Therefore, this study aims to evaluate the physical properties and nutrient content of composts made from WH, KW, CD, FYM, PL, and their combinations.

2. MATERIALS AND METHOD

2.1 Site, Composting Materials and Experimental Design

This experiment was conducted at the Germplasm Centre of Agrotechnology Discipline of Khulna University, Khulna, Bangladesh during January to March 2014 with water hyacinth (WH), kitchen waste (KW), and three manures [cow dung (CD), farmyard manure (FYM), and poultry litter (PL)] as composting materials. The experiment was laid out in randomized complete block design (RCBD) with 15 treatments viz. WH, KW, CD, FYM, PL, WH:KW (1:1), WH:CD (1:1), WH:FYM (1:1), WH:PL (1:1), KW:CD (1:1), KW:FYM (1:1), KW:PL (1:1), CD:FYM (1:1), CD:PL (1:1), and FYM:PL (1:1) and three replications. WH was collected from the canal of the Khulna University; KW from Gallamari Bazar just east of the campus and CD, FYM, and PL from nearby farms. Among the composting materials, WH and KW were chopped into smaller pieces for aid in rapid decomposition.

2.2 Composting Process

Composting was done following pit method. Pit (4'x2'x3') was prepared in a dry place under the tree ensuring no moisture leaking into it from surroundings and polythene was placed equally in every pit for preventing nutrient leaching down to the soil. According to treatments, composting materials were piled up in different thickness and set up in the pit.

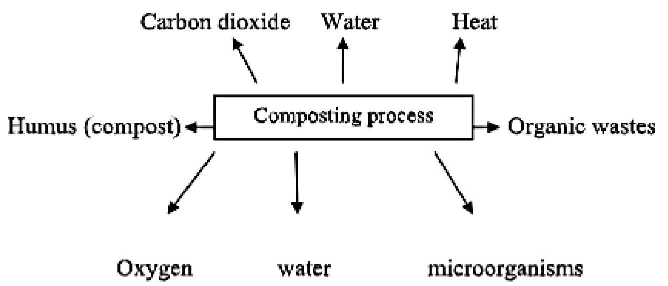

Figure 1: Inputs and outputs of the composting process (Ahmad et al., 2007)

The heap was shuffled after one week to enhance the composting process by decomposing, blending and breaking up the composting materials. Aerobic condition was maintained for proper decomposition. The heap was moistened by spraying water on the surface during hot and sunny weather and then mixed. It took three months to complete the process.

2.3 Sample Collection, Preparation, and Analysis

After completion of composting, samples were collected randomly from each pit and analysed for color, texture, and odor. After physical examination, the samples were air dried by spreading under shade, packed in brown-paper envelope and placed in an oven at 60 °C for a few days to get dry weight. One g of dry sample from each treatment was subjected to acid digestion with a diacid mixture to determine total nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulphur (S), Zinc (Zn), and boron (B) content at the Soil Chemistry Lab of Khulna University. A mixture of HNO_3 and $HClO_4$ (2: 1) was used to determine all the nutrients except N and for N, a mixture of H_2SO_4 and $HClO_4$ (2:1) was used. One g finely ground dry sample along with 20 ml diacid mixture was placed in a 250ml conical flask, stirred and heated (hot plate) at 180-200 ^{0}C until white fume evolved.

The flask was allowed to cool; added 20-30ml distilled water and shook well. The aliquot was filtered in a 100-ml conical flask with Whatman Filter Paper and distilled water was added to make the final volume 100 ml. The digested samples were sent to the Soil Resources and Development Institute at Daulatpur of Khulna for nutrient analysis. Total N content was measured following Kjeldahl digestion; P by Olsen; K by atomic absorption; and Ca and Mg by ammonium acetate method (Kjeldahl, 1883). The total S was determined by calcium dihydrogen phosphate extraction; Zn by DTPA (diethylenetriaminepentaacetic acid) extraction and B by calcium chloride extraction method.

2.4 Data Analysis

The data were analysed statistically using analysis of variance ANOVA by MSTAT-C. Means were compared for difference by New Duncan's Multiple Range Test (DMRT).

3. RESULTS AND DISCUSSION

3.1 Color, Texture, and Odor of Compost

Color, texture, and odor of composts were evaluated for the matured compost (Table 1). The color of the matured composts varied from dark brown to black. However, composts made with kitchen waste or in combination with kitchen waste and water hyacinth (1:1) were dark grey. The color of mature compost was dark brown to black (Darlington, 2007). Final compost is usually a dark brown material in which source material remain unidentified with no further decomposition (Sullivan et al., 2018). Among the 15 composts, one (CD) had small, five (FYM, PL, CD: FYM, CD: PL, and FYM: PL) had fine and the rest nine had large texture. The texture of matured compost was crumby in which larger particles change into finer ones. Texture of the compost depends on composting materials (wheat, hemp, and miscanthus) that affect water retention, particle size distribution, C/N ratio, and the amount of mineralized nitrogen of compost (Dresbøll and Thorup-Kristensen, 2005). Many of the composts smelt earthy. However, a few were odorless or produced bad smell. Generally, immature compost contains ammonia or organic acids with a bad smell and they can even kill the plants (Sullivan et al., 2018). The odor of the mature compost should be a soil-like or musty and having a sour or putrid smell indicates that the compost is not yet matured (Darlington, 2007).

Table 1: Color and Texture of Different Types of Composts.

Treatments	Name of Treatments	Color	Texture
T_1	Water hyacinth (WH)	Grey	Large
T_2	Kitchen waste (KW)	Black	Large
T_3	Cow dung (CD)	Brown	Small
T_4	Farmyard Manure (FYM)	Blackish brown	Fine
T_5	Poultry litter (PL)	Dark brown	Fine
T_6	WH:KW (1:1)	Black	Large
T_7	WH:CD (1:1)	Brown	Large
T_8	WH:FYM (1:1)	Greyish brown	Large
T_9	WH:PL (1:1)	Dark brown	Large
T_{10}	KW:CD (1:1)	Blackish grey	Large
T_{11}	KW:FYM (1:1)	Blackish grey	Large
T_{12}	KW:PL (1:1)	Brown	Large
T_{13}	CD:FYM (1:1)	Blackish brown	Fine
T_{14}	CD:PL (1:1)	Blackish brown	Fine
T_{15}	FYM:PL (1:1)	Blackish brown	Fine

3.2 Nutrient Content of Composts

The total nutrient contents of matured composts were evaluated for nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulphur (S), zinc (Zn) and boron (B).

3.2.1 Nitrogen (N)

Total N includes all forms of nitrogen such as organic N, ammonium N (NH_4-N), and nitrate N (NO_3-N). Total N content (ppm) varied significantly and ranged from 75-1541 ppm among the composting materials (Table 2). The highest total N content (1541 ppm) was obtained from CD: FYM which was statistically similar with WH: PL (1540) and WH: FYM (1402) (Table 2). The lowest value of total nitrogen (75 ppm) was estimated from FYM: PL. Total N content did not differ among WH, CD, WH: KW, and KW: FYM. The total N content of composts made from paddy straw, paddy straw amended with cattle dung, cattle manure, residues of herbal plant and sugarcane plant varied from 0.95% to 2.17% (Goyal and Sindhu, 2011; Khater, 2015). The highest total N content (2.24%) was reported from compost made through Novcom composting method (Seal et al., 2011). N content of a compost varies depending on material used and process of composting followed. Finished compost usually have N: P_2O_5 : K_2O :: 1:1:1. Composts generally contain 2% N (Petruzzello, 2021). A compost with <1% N requires supplemental N fertilization while >2% total N can replace some nitrogenous fertilizers (Sullivan et al., 2018). Compost produced in the present study had very low total N that may be due to low N content of composting materials.

Table 2: Total Nitrogen Content in Compost as Influenced by Composting Materials.

Treatments	Name of Treatments	Nitrogen (ppm)
T_1	Water Hyacinth (WH)	1230 b
T_2	Kitchen Waste (KW)	771 cd
T_3	Cow Dung (CD)	1193 b
T_4	Farmyard Manure (FYM)	825 cd
T_5	Poultry Litter (PL)	563 d
T_6	WH:KW (1:1)	980 bc
T_7	WH:CD (1:1)	563 d
T_8	WH:FYM (1:1)	1402 ab
T_9	WH:PL (1:1)	1540 a
T_{10}	KW:CD (1:1)	841 i
T_{11}	KW:FYM (1:1)	1188 b
T_{12}	KW:PL (1:1)	560 d
T_{13}	CD:FYM (1:1)	1541 a
T_{14}	CD:PL (1:1)	143 ef
T_{15}	FYM:PL (1:1)	75 f
Level of Significant		**
CV%		13.88%

Means in a column followed by the same letters are not statistically different according to New Duncan's Multiple Range Test ($P \le 0.05$); **=Significant at 1% level; CV = Coefficient of variation.

3.2.2 Phosphorus (P)

The phosphorus content (ppm) ranged from 2184 to 8974 for different composts. The highest value of total phosphorus (8974 ppm) was reported from FYM: PL (1:1) which was statistically similar with WH: PL, CD: PL, KW, and PL and the lowest total phosphorus (2184 ppm) was calculated from WH alone (Table 3). Generally, PL alone or in combination with other treatments had higher P content; similarly, WH alone or in combination with other treatments had lower P contents. However, combination of PL and WH had higher P (8455 ppm) content suggesting a synergistic effect between PL and WH that increased total P content. The total P content varies from 2700 ppm to 11300 ppm in composts made from solely cattle manure, herbal plant residue, or sugarcane plant residue or in combinations of them (Khater, 2015).

Table 3: Phosphorus Content in Composts as Influenced by Composting Materials.

Treatments	Name of treatments	Phosphorus (ppm)
T_1	Water hyacinth (WH)	2184 d
T_2	Kitchen waste (KW)	8207 a
T_3	Cow dung (CD)	4739 c
T_4	Farmyard Manure (FYM)	5256 bc
T_5	Poultry litter (PL)	7651 ab
T_6	WH:KW (1:1)	2580 d
T_7	WH:CD (1:1)	5581 bc
T_8	WH:FYM (1:1)	2568 d
T_9	WH:PL (1:1)	8455 a
T_{10}	KW:CD (1:1)	6602 b
T_{11}	KW:FYM (1:1)	5477 bc
T_{12}	KW:PL (1:1)	6172 b
T_{13}	CD:FYM (1:1)	3487 cd
T_{14}	CD:PL (1:1)	8276 a
T_{15}	FYM:PL (1:1)	8974 a
Level of Significant		**
CV%		16.14%

Means in a column followed by the same letters are not statistically different according to New Duncan's Multiple Range Test ($P \le 0.05$); **=Significant at 1% level; CV = Coefficient of variation.

The total P content varies from 6100 ppm to 8100 ppm in Novcom composting method (Seal et al., 2011). Standard range of total P in a compost varies from 3000 ppm - 9000 ppm. If it had <3000 ppm P, it requires P fertilization based on soil analysis report and if it had >7000 ppm total P, it indicates presence of a manure in the compost (Sullivan et al., 2018). Composts generally contain 0.5-1% P (Petruzzello, 2021). Most of the composts had sufficient total P in this study (Table 3). Moreover, P content gradually increased during the composting process. The water solubility of phosphorous decreased with the humification through the action of compost accelerator microorganisms (Elango et al., 2009).

3.2.3 Potassium (K)

The highest K content was obtained from WH: PL (16640 ppm) which was significantly higher from KW (11730 ppm), KW: PL (10730 ppm), CD: PL (10730 ppm) or PL (9763 ppm) (Table 4). The lowest K was reported from FYM (2863 ppm) and it was statistically similar with KW: FYM (2925 ppm), CD (2928 ppm), and CD: FYM (3903 ppm). The total K content varies from 2700 ppm to 21100 ppm in composts made either solely or in combination of cattle manure, herbal plant residue, or sugarcane plant residue (Khater, 2015). The total K content varies from 7400 ppm to 11900 ppm in Novcom composting method (Seal et al., 2011). Standard range of total K in a compost varies from 5000 ppm -15000 ppm. If it had >15000 ppm total K, it indicates presence of a manure in the compost (Sullivan et al., 2018). Composts generally contain 2% K (Petruzzello, 2021). Though K increases during the period of composting, it is easily leachable (Gallardo-Lara and Nogales, 1987).

Table 4: Potassium Content of Composts as Affected by Composting Materials.

Treatments	Name of Treatments	Potassium (ppm)
T_1	Water hyacinth (WH)	7733 cd
T_2	Kitchen waste (KW)	11730 b
T_3	Cow dung (CD)	2928 f
T_4	Farmyard Manure (FYM)	2863 f
T_5	Poultry litter (PL)	9763 bc
T_6	WH:KW (1:1)	6052 de
T_7	WH:CD (1:1)	6853 d
T_8	WH:FYM (1:1)	5861 de
T_9	WH:PL (1:1)	16640 a
T_{10}	KW:CD (1:1)	5852 de
T_{11}	KW:FYM (1:1)	2925 f
T_{12}	KW:PL (1:1)	10730 b
T_{13}	CD:FYM (1:1)	3903 ef
T_{14}	CD:PL (1:1)	10730 b
T_{15}	FYM:PL (1:1)	7750 cd
Level of Significant		**
CV%		12.96%

Means in a column followed by the same letters are not statistically different according to New Duncan's Multiple Range Test ($P \le 0.05$); **=Significant at 1% level; CV = Coefficient of variation.

3.2.4 Calcium (Ca)

The lowest calcium concentration (80 ppm) was reported from FYM: PL (1:1) which was significantly lower than all other treatments. In fact, the second lowest Ca was obtained from CD that was even 15 times higher than the lowest one suggesting antagonistic effect between FYM and PL that may make the Ca unavailable. PL is usually rich in P that may precipitate as calcium phosphate resulting very low calcium content. The highest Ca was calculated from the combination of WH and FYM (2858 ppm) which was statistically similar with combination of KW and PL (2741 ppm) (Table 5). Standard range of total Ca in a compost varies from 15000 ppm - 35000 ppm. If it had >40000 ppm total Ca, it indicates presence of soil, gypsum or lime in the compost (Sullivan et al., 2018). All the composts had very low total Ca that may be due to low Ca content of composting materials or high P content that leads to precipitation.

Table 5: Calcium Content of Different Composts as Affected by Composting Materials.

Treatments	Nameof Treatments	Calcium (ppm)
T_1	Water Hyacinth (WH)	2453 bc
T_2	Kitchen Waste (KW)	1717 fg
T_3	Cow Dung (CD)	1200 h
T_4	Farmyard Manure (FYM)	1663 fg
T_5	Poultry Litter (PL)	2300 cd
T_6	WH:KW (1:1)	2420 bc
T_7	WH:CD (1:1)	2299 cd
T_8	WH:FYM (1:1)	2858 a
T_9	WH:PL (1:1)	1865 ef
T_{10}	KW:CD (1:1)	1418 gh
T_{11}	KW:FYM (1:1)	1603 fg
T_{12}	KW:PL (1:1)	2741 ab
T_{13}	CD:FYM (1:1)	2060 de
T_{14}	CD:PL (1:1)	2365 cd
T_{15}	FYM:PL (1:1)	80 i
Level of Significant		**
CV%		6.73%

Means in a column followed by the same letters are not statistically different according to New Duncan's Multiple Range Test ($P \leq 0.05$); **=Significant at 1% level; CV = Coefficient of variation.

3.2.5 Magnesium (Mg)

Mg content of the matured compost ranged from 43 ppm (FYM: PL) to 1168 ppm (WH: FYM) (Table 6). However, WH (1119 ppm) and KW: FYM (1022 ppm) had statistically similar Mg content of WH: FYM. Standard range of total Mg in a compost varies from 2500 ppm – 7000 ppm. An imbalance of Mg (>7500 ppm) and K (<15000 ppm) can affect plant growth (Sullivan et al., 2018). All the composts had insufficient Mg, which may be due to low Mg content of composting materials.

Table 6: Magnesium Content in Various Composts Depending on Composting Materials.

Treatments	Name of treatments	Magnesium (ppm)
T_1	Water hyacinth (WH)	1119 a
T_2	Kitchen waste (KW)	693 c
T_3	Cow dung (CD)	705 cd
T_4	Farmyard Manure (FYM)	779 c
T_5	Poultry litter (PL)	936 b
T_6	WH:KW (1:1)	936 b
T_7	WH:CD (1:1)	972 b
T_8	WH:FYM (1:1)	1168 a
T_9	WH:PL (1:1)	742 cd
T_{10}	KW:CD (1:1)	511 de
T_{11}	KW:FYM (1:1)	1022 ab
T_{12}	KW:PL (1:1)	708 cd
T_{13}	CD:FYM (1:1)	839 bc
T_{14}	CD:PL (1:1)	694 d
T_{15}	FYM:PL (1:1)	43 f
Level of Significant		**
CV%		8.86%

Means in a column followed by the same letters are not statistically different according to New Duncan's Multiple Range Test ($P \leq 0.05$); **=Significant at 1% level; CV = Coefficient of variation.

3.2.6 Sulphur (S)

CD in combination with PL resulted highest amount of S (6524 ppm) that was statistically similar with the compost prepared from combination of CD and KW (Table 7). The lowest amount of S was reported from the combination of FYM and PL (182 ppm) which was statistically similar with CD (818 ppm) and KW: CD (880 ppm). The variation of sulphur concentrations mainly depends on the decomposition of final compost. Standard range of total S in a compost varies from 2500 ppm – 8000 ppm. A compost having >8000 ppm S indicates that gypsum was added (Sullivan et al., 2018). Compost prepared from MSW: MOC: CD (5:2:3) had 0.45% S which increased to 0.52% when CD is replaced with equal amount of PM (Sultana et al., 2018). Some of the prepared composts had sufficient S.

Table 7: Sulphur Content in Composts as Affected by Composting Materials.

Treatments	Name of Treatments	Sulphur (ppm)
T_1	Water hyacinth (WH)	1573 de
T_2	Kitchen waste (KW)	2055 d
T_3	Cow dung (CD)	818 ef
T_4	Farmyard Manure (FYM)	4368 b
T_5	Poultry litter (PL)	1267 e
T_6	WH:KW (1:1)	1558 de
T_7	WH:CD (1:1)	880 ef
T_8	WH:FYM (1:1)	2040 d
T_9	WH:PL (1:1)	4467 b
T_{10}	KW:CD (1:1)	5947 a
T_{11}	KW:FYM (1:1)	4543 b
T_{12}	KW:PL (1:1)	2265 d
T_{13}	CD:FYM (1:1)	3227 c
T_{14}	CD:PL (1:1)	6524 a
T_{15}	FYM:PL (1:1)	182 f
Level of Significant		**
CV%		10.35%

Means in a column followed by the same letters are not statistically different according to New Duncan's Multiple Range Test ($P \leq 0.05$); **=Significant at 1% level; CV = Coefficient of variation.

3.2.7 Zinc (Zn) and Boron (B)

Table 8: Amount of Zinc in Compost as Affected by Composting Materials.

Treatments	Name of Treatments	Zinc (ppm)
T_1	Water Hyacinth (WH)	313 ab
T_2	Kitchen Waste (KW)	103 ef
T_3	Cow Dung (CD)	102 ef
T_4	Farmyard Manure (FYM)	193 d
T_5	Poultry Litter (PL)	97 ef
T_6	WH:KW (1:1)	94 ef
T_7	WH:CD (1:1)	80 f
T_8	WH:FYM (1:1)	239 c
T_9	WH:PL (1:1)	123 ef
T_{10}	KW:CD (1:1)	126 e
T_{11}	KW:FYM (1:1)	276 bc
T_{12}	KW:PL (1:1)	124 ef
T_{13}	CD:FYM (1:1)	272 bc
T_{14}	CD:PL (1:1)	318 a
T_{15}	FYM:PL (1:1)	10 g
Level Of Significant		**
CV%		10.31%

Means in a column followed by the same letters are not statistically different according to New Duncan's Multiple Range Test ($P \leq 0.05$); **=Significant at 1% level; CV = Coefficient of variation.

The highest Zn (318 ppm) was recorded from the combination of CD and PL that was statistically similar with WH (313 ppm). The lowest Zn concentration (10 ppm) was found from combination of FYM and PL, which was statistically different from all other treatments (Table 8). Similarly, lowest B (17 ppm) was reported from FYM: PL. B content of WH, KW, FYM, WH: FYM, WH: PL, KW: FYM, KW: PL, and CD: PL did not differ significantly. The highest concentration of B (542 ppm) was estimated from combination of CD and FYM that was statistically similar with KW: CD (Table 9).

Table 9: Boron Content in Composts as Influenced by Composting Materials.

Treatments	Name of Treatments	Boron (ppm)
T_1	Water Hyacinth (WH)	390 bc
T_2	Kitchen Waste (KW)	415 bc
T_3	Cow Dung (CD)	381 c
T_4	Farmyard Manure (FYM)	463 b
T_5	Poultry Litter (PL)	224 e
T_6	WH:KW (1:1)	305 d
T_7	WH:CD (1:1)	190 e
T_8	WH:FYM (1:1)	396 bc
T_9	WH:PL (1:1)	414 bc
T_{10}	KW:CD (1:1)	535 a
T_{11}	KW:FYM (1:1)	396 bc
T_{12}	KW:PL (1:1)	451 bc
T_{13}	CD:FYM (1:1)	542 a
T_{14}	CD:PL (1:1)	456 bc
T_{15}	FYM:PL (1:1)	17 f
Level of Significant		**
CV%		7.93%

Means in a column followed by the same letters are not statistically different according to New Duncan's Multiple Range Test ($P \leq 0.05$); **=Significant at 1% level; CV = Coefficient of variation.

4. Conclusions

The color of the composts varies from dark brown to black with earthy smell and most of them had large texture. Compost prepared from cow dung and farmyard manure had highest total N and B. Similarly, composting of cow dung with poultry litter resulted highest total S and Zn. Moreover, Poultry litter with farmyard manure had highest total P and poultry litter with water hyacinth had highest total K. Water hyacinth and farmyard manure produced composts that had highest Ca and Mg. Therefore, combination resulted better nutrient content of composts compared to any single composting material used in this experiment and thus water hyacinth can be used as a composting material.

Acknowledgments

The authors express their sincere appreciation and gratefulness to the Khulna University for providing logistics to accomplish the experiments.

Funding Details

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosure Statement

There are no competing interests to declare.

Data Availability Statement

All the data are included in the manuscript.

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