



# Influence of Different Substrates on Nutrient Composition of Vermicompost and Vermiwash

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

The present study was conducted to evaluate the effect of different substrates on nutrient composition of vermicompost and vermiwash at Division of Soil Science, College of Agriculture, Pune during 2022-23. High density polyethylene beds of 12 X 4 X 2 feet size were used for production of vermicompost. While 200 liter capacity plastic barrels were employed for vermiwash preparation. There were five treatments of substrate combination like 25% rain tree litter (RTL) + 75% paddy straw spent mushroom compost (PSSMC); 50%tree litter+50% paddy straw spent mushroom compost (PSSMC); 75% tree litter+25% paddy straw spent mushroom compost (PSSMC); 100% rain tree litter, 100% paddy straw spent mushroom compost (PSSMC) were used for the preparation of vermicompost with earthworm *Eisenia fetida* and replicated four times in completely randomized block design. There were ten plastic barrels of above capacity were used

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for by using vermicompost prepared from different substrate combinations. The sampling, harvesting and characterization of vermiwash was done in duplicate for first and second harvest after incubation period of 15 days.

Results showed that pH, EC, organic matter, C: N ratio, total nitrogen, phosphorus, potassium, iron, zinc, manganese, copper in vermicompost were significantly influenced by different proportions of rain tree litter and paddy straw spent mushroom compost. C: N ratio of vermicompost prepared by using rain tree litter and paddy straw spent mushroom compost was ranged between 9.71 and 16.19. Significantly higher total nitrogen (2.31%), phosphorus (1.185%), potassium (0.863%), iron (1072 mg kg<sup>-1</sup>), manganese (231.50 mg kg<sup>-1</sup>), zinc (254 mg kg<sup>-1</sup>) and copper (54.25 mg kg<sup>-1</sup>) were noted in vermicompost from 100% rain tree litter. Significantly high EC (total soluble salts) at first and second harvest of vermiwash was reported when 100% rain tree litter compost and vermicompost as substrate used. Further, vermiwash prepared by using vermicompost from rain tree litter reported significantly higher nitrogen (0.65 and 0.51%), phosphorus (0.33 and 0.27%) and potassium (0.27 and 0.23%) content at both harvest respectively but higher content was in first harvest. Vermiwash prepared from 100% raintree litter vermicompost reported significantly higher Fe, Mn, Zn and Cu content at both harvesting stage.

*Keywords: Rain tree litter waste; spent mushroom compost; vermicompost; vermiwash.*

## 1. INTRODUCTION

Soil fertility decline over the globe is one of the major cause for decreasing nutrient use efficiency and crop productivity. Health and quality of soil deteriorating consistently due to soil erosion, less use of organic manures, injudicious use of irrigation water and fertilizers, mono-cropping, no soil testing, poor crop management, reluctant for green manuring crops etc. are the major causes for declining soil fertility resulted in less nutrient use efficiency. In order to improve health and quality of soil, it is necessary to adopt integrated nutrient management system. Green manuring, compost, vermicompost, vermiwash etc. are important components of INM. Uses of FYM and compost have high bulkiness per unit nutrient content which seems to be a constraint for transport and application. The review reflected that earthworm a considerable amount of plant hormones in their body secretions. Earthworm processed material from the body called casts contain several soil nutrients in plant usable form. Compost enrichment and vermicomposting are effective methods of recycling distinct bio-wastes into compost or vermicompost employing microbes and earthworms. "Since the intestine of earthworms harbor wide ranges of microorganisms, enzymes, hormones, etc., these half-digested substrates decompose rapidly and are transformed into a form of vermicompost within a short time" (Edwards and Lofty 1972). "The final product is a stabilized vermicompost, well humidified, organic manure, with rich in beneficial microflora favorable for improvement in physical, chemical and biological soil properties.

The biochemical conversions during degradation of organic matter are carried out via enzymatic digestion, enrichment by nutrient excrement and transport of organic and inorganic materials. The vermicast is mixed with mucus secretions of the gut wall, and of the microbes and transformed into vermicompost" (Edwards and Lofty 1972). The degradation process continues even after the release of the cast by the earthworms with microorganisms. The studies on the effect of vermicomposting on some components of organic waste showed that vermicompost enhances degree of polymerization of humic substances along with a decrease of ammonium N and an increase of nitric N [1-4]. The plant growth regulators and other plant growth influencing materials, that is, auxins, cytokinins, humic substances, etc., produced by microorganisms have been reported from vermicompost" [5].

"Liquid vermiwash is a natural product formed by vermicomposting of organic matter from rich population of earthworms, vermicast and vermicompost. The characterization of vermiwash and its quality depends on nature of organic matter used during decomposition and vermicomposting [6,7]. Vermiwash contains hormone, mucous, enzyme, vitamins, proteins, different macro and micronutrients, and a large number of microbes. As compared to application of solid vermicompost, its liquid form (vermiwash) is more suitable due to its bioavailability to reach quickly to targeted area around the roots of plants (Gudeta et al (2020). Further, vermiwash is a coelomic fluid of earthworms which contains several enzymes, plant growth hormones,

vitamins along with micro and macronutrients. It contains excretory products of earthworm secretions, the worm coelomic fluid oozing through dorsal pores, mucus, enzymes secreted by worm & microorganisms, plant nutrients, vitamins & plant growth promoting substances. It also contains plant growth hormones (auxin & cytokinin) and nitrate fixing bacteria and phosphorus solubilizing bacteria [8,9].

“Enrichment of compost or vermicompost by using locally available nutrient rich organic matter like raintree litter available abundantly can be used efficiently for nutrient enrichment. Its leaves and twigs contain substantial amounts of N, P, K, S and other micronutrients. Raintree leaves can be used in soil as green or brown manure to increase soil and crop productivity” [10]. Higher nitrogen content in the rain tree litter ranges from 1.88 to 2.25 while phosphorus was 0.8 to 1.1% and potassium to the tune of 1% can be suitably used for nutrient enrichment [11,12].

Rain trees of 25 to 35 feet height with average age of 125 to 150 years old falls leaf litter in winter in the campus of College of Agriculture, Pune. Mushroom spent compost is also generated in the campus after the harvest of oyster and button mushrooms. Rain tree leaves/litter is rich in nitrogen, phosphorus and potassium that can be used to enrich vermicompost and vermiwash in combination with mushroom spent compost. Hence, the attempt was made to study “influence of rain tree litter and mushroom spent compost combinations on the nutrient composition of vermicompost and vermiwash.

## 2. MATERIALS AND METHODS

The experiment was carried out to study enrichment of vermicompost and vermiwash by using raintree litter and mushroom spent compost at Vermicompost Yard of Division of Soil Science, College of Agriculture, Pune during 2021-22. The treatment consisted various proportions of rain tree litter and paddy straw spent mushroom compost that were used for the production of vermicompost. HDPE vermibed of size 12 X 4 X 2 feet (Fig. 2) were used for this study. The five substrate combinations viz. 25% rain tree litter (RTL) + 75% paddy straw spent mushroom compost (PSSMC), 50% tree litter + 50% paddy straw spent mushroom compost (PSSMC), 75% tree litter + 25% paddy straw spent mushroom compost (PSSMC), 100% rain tree litter, 100% paddy straw spent mushroom

compost (PSSMC) were studied in completely randomized block design replicated four times.

### 2.1 Method for Preparation of Vermicompost from Different Substrates

Total 20 HDPE vermibeds were installed by fixing sixteen bamboo sticks of 2.5 feet height. (Fig. 1). The essential quantity of rain tree litter was collected from the campus of College while paddy spent mushroom compost (PSSMC) was procured from AICRP on Mushroom Project, College of Agriculture, Pune.

Rain tree litter and paddy straw discarded mushroom compost were properly blended on a dry weight basis based on the treatment protocol. Each bed includes 4000 kg of organic waste derived from either rain tree litter or paddy straw spent mushroom compost (Table 1). The treatment-wise rain tree litter and paddy straw wasted mushroom compost were partially degraded for 45 days using the pit method before being used for vermicomposting. The vermibeds were filled layer by layer with 10-15 cm thickness of undecomposed fresh rain tree litter, paddy straw, and spent mushroom waste according to the treatment protocol. A second layer of similar thickness was applied using partially digested organic waste from the corresponding treatment. The third layer was applied uniformly over the second layer using cow dung slurry (40 lit. cow dung + 100 lit. water + 1 kilogram decomposing culture). Similar alternative piling was completed up to a height of 70 to 80 cm for the HDPE vermibeds. Then watering started, and the entire material got to soak in the water. After 15-20 days, 3 kg of *Eisenia fetida* earthworms (Fig. 1) had been released in each vermibed. The moisture content was maintained at 50-55% until the vermicompost was retrieved. The wet gunny bags were put to use to cool down the surface. The composition of rain tree litter and paddy straw spent mushroom compost were carried out according to the standard methods given by A.O.A.C [13] and presented in Table 2.

### 2.2 Method for Preparation of Vermiwash from Different Substrates

Plastic drums of 200 liter capacity along with open/close (on/off) tap fitted at 4 inch from bottom (for harvesting of vermiwash) were used for vermiwash preparation (Fig. 3). The ten plastic drums were filled with the

layering adopted as stated in Table 3. Two vermish drums were kept for one treatment and quadruplicate sampling of vermish from each drum was carried out for assessing characterization and nutrient composition. The treatment wise rain tree litter and paddy straw spent mushroom compost were allowed to partially degrade for 45 days and thereafter used for vermicomposting.

Vermicompost prepared from various proportions of raintree litter and paddy straw spent mushroom compost was used for extracting vermish. Bricks pieces, gravel, coarse and fine sand, plastic net, cow dung, partially decomposed compost and vermicompost of respective treatment, earthworms and gunny bags were used for filling the vermish drum.

**Table 1. Quantity of substrates used in each bed**

Treatment no.	Substrate proportion	Quantity of substrates (kg)	
		Rain tree litter	Paddy straw spent mushroom compost
T1	25% RTL +75% PSSMC	1000	3000
T2	50% RTL +50% PSSMC	2000	2000
T3	75% RTL +25% PSSMC	3000	1000
T4	100% RTL	4000	-
T5	100% PSSMC	-	4000

**Table 2. Nutrient content in rain tree litter and paddy straw spent mushroom compost**

Sr. no.	Parameter	Rain tree litter	Paddy straw mushroom compost
1	pH (1:10)	7.6	7.3
2	EC dS m <sup>-1</sup> (1:10)	1.22	0.44
3	Organic carbon (%)	118	41
4	N (%)	2.08	0.66
5	P (%)	0.98	0.45
6	K (%)	0.79	0.38
7	Fe (mg kg <sup>-1</sup> )	186	54
8	Mn (mg kg <sup>-1</sup> )	78	27
9	Zn (mg kg <sup>-1</sup> )	69	22
10	Cu (mg kg <sup>-1</sup> )	29	21
11	C:N ratio	56.73	62.21
12	C:P ratio	120.40	91.11

**Table 3. Layering in the vermish drum**

First Layer (from bottom) (15-20 cm Thick)	Bricks pieces 75-100 nos.
Second Layer (10-15 cm Thick)	Coarse sand 25 kg
Third Layer (5-10 cm)	Fine Sand (size 2-3 cm) 25 kg
Fourth Layer (15-25 cm)	Partially decomposed compost (100 to 150 kg) mixed with cow dung (15-20 days old) 50 to 60 kg
Fifth Layer (5 To 10 cm)	Vermicompost approximately 40 to 80 kg
Sixth Layer	Earthworms of species ( <i>Eisenia fetida</i> ) 4-5 kg or 1000 to 1500 numbers.
Seventh Layer	Vermicompost + cow dung (15-20 days old) in 50:50 proportion 50 kg
Eighth Layer	Partially decomposed compost (100 to 150 kg) mixed with cow dung (15-20 days old) 50 to 60 kg
Ninth Layer	Vermicompost (40 to 80 kg)
Tenth Layer	Wet gunny bags



**Fig. 1. Earthworms of species *Eisenia fetida***



**Fig. 2. HDPE vermibeds (12X4X2)**



**Fig. 3. Vermiwash unit with 200 litre plastic drums**

The vermivash drums were filled layer wise (Table 3). After filling vermivash drums, they were allowed for incubation up to 15 days (Fig. 2). The moisture content was maintained 50-55 per cent in the vermivash drums. After 15 days of incubation, 10 liter of water added in

each drum and allowed to saturate for 48 to 50 hours for incubation and then treatment wise vermivash harvested. Harvested vermivash was analyzed for characterization and nutrient composition by following standard methods [13].

### 3. RESULT AND DISCUSSION

#### 3.1 Nutrient Enrichment in Vermicompost as Influenced by Substrates

The nutrient content in vermicompost as influenced by various substrates in different proportions was presented. (Table 4 and 5 and Figs. 4 and 5). Rain tree litter and paddy straw discarded mushroom compost have been observed to have a substantial influence on the chemical properties of vermicompost, including its EC, organic matter content, and C:N ratio. When utilizing various combinations of rain tree litter and paddy straw wasted mushroom compost, non-significant results were found for the "days required for vermicompost."

It could be seen from the data that similar period was required for the formation of vermicompost by using 100% rain tree litter (54 days) and for 100% paddy straw spent mushroom compost (56 days). The use of rain tree litter and paddy straw wasted mushroom compost in varying proportions yielded non-significant pH results for vermicompost. The lowest pH (6.65) has been found in vermicompost produced with 100% paddy straw spent mushroom compost, but the highest pH (7.20) was attained with 50% rain tree litter and 50% paddy straw spent mushroom compost. The EC of vermicompost fluctuated between 1.55 to 2.80 dSm<sup>-1</sup>. Vermicompost produced from 100% rain tree litter having far greater EC (2.80 dSm<sup>-1</sup>), followed closely by 50% rain tree litter and 50% paddy straw spent mushroom compost. A lower EC (1.55 dSm<sup>-1</sup>) was noticed with 100% paddy straw wasted mushroom compost.

The organic matter content in vermicompost made from raintree litter and PSSMC ranged from 27.85 to 33.84 %. Utilizing 100% paddy straw spent mushroom compost gave rise to much lower organic matter (21.50 %) in vermicompost, which was equivalent to 50% rain tree litter and 50% paddy straw spent mushroom compost (21.38%). Lower organic matter in paddy straw discarded mushroom compost might be because the straw had previously been digested by oyster mushroom (*Pleurotus sajarcaju*). The C:N ratio of these vermicomposts produced by rain tree litter and paddy straw wasted mushroom compost varied between 9.71 to 16.19. The combination of fifty percent rain tree litter and fifty per cent paddy straw spent mushroom compost achieved a much lower C:N ratio of 9.71 %, which was statistically on par

with 100% rain tree litter (8.08) and 75% rain tree litter and 25% paddy straw spent mushroom compost (10.35).

The rate of decomposition of any organic matter is influenced by its total carbon and total nitrogen proportions. The carbon-to-nitrogen ratio is a key indicator which correlates decomposition reactions to the relative amounts of the essential chemical elements required for microbial population growth and metabolism. Organic matter with a lower C:N ratio at the beginning stages of decomposition demonstrates higher microbial activity and CO<sub>2</sub> evolution, which causes a faster rate of decomposition. However, organic matter possessing a higher C:N ratio generates greater amounts of carbon dioxide as well as methane at a later stage, leading decomposition to take longer.

Carbohydrates, for example, will supply the energy required for microbial metabolic activity in addition to supplying carbon for the microbial biomass. Nitrogen is an essential component of proteins and amino acids required for microbial biomass growth. To maintain an active microbial population during composting, the available carbon-to-nitrogen ratio should be kept at an appropriate level.

Lower ratios results in nitrogenous compound losses, whereas greater levels slow the composting process. As a result, the nitrogen content of rain tree litter was higher than that of paddy straw wasted mushroom compost, requiring a shorter time frame for rain tree litter vermicompost than the other treatments. Furthermore, the C:N ratio can be regulated by selecting the best combination of organic matter comprising rain tree litter, paddy straw, and mushroom compost. In these investigations, vermicomposts produced with different combinations of organic matter have been shown to have a C:N ratio of less than 30, suggesting good compost quality and a high rate of mineralization after application to soil. The narrower the C:N ratio, more rapidly nitrogen is released into the soil for crop utilization (Martin, 2007).

Overall nitrogen, phosphorus, and potassium content of vermicompost produced from different mixtures of rain tree litter and paddy straw wasted mushroom compost varied from 1.08 to 2.31%, 0.433 to 1.185%, and 0.343 to 0.863%, respectively (Table 5). The data show that as the quantity of rain tree litter in paddy straw wasted

mushroom compost increases, it also improves the nutrient content of the vermicompost. Rain tree litter provided a greater increase in nutrient enrichment than paddy straw-spent mushroom compost. The amount of metallic micronutrients (Fe, Mn, Zn, and Cu) in vermicompost is highly dependent on the substrate and its proportions. The Fe, Mn, Zn, and Cu concentrations in vermicompost ranged from 439 to 1072 mg kg<sup>-1</sup>, 105.25 to 231.50 mg kg<sup>-1</sup>, 57 to 254 mg kg<sup>-1</sup>, and 15.50 to 54.25 mg kg<sup>-1</sup>, respectively.

The data showed that the vermicompost produced using 100% rain tree litter contains considerably higher concentrations of Fe (1072 mg kg<sup>-1</sup>), Mn (231.50 mg kg<sup>-1</sup>), Zn (254 mg kg<sup>-1</sup>), and Cu (54.25 mg kg<sup>-1</sup>). However, vermicompost made from rice straw wasted mushroom compost possesses a lower content of Fe (640 mg kg<sup>-1</sup>), Mn (152.00 mg kg<sup>-1</sup>), Zn (141 mg kg<sup>-1</sup>), and Cu (34.50 mg kg<sup>-1</sup>). The vermicompost prepared with 100% rain tree litter contained higher concentrations of nitrogen, phosphorous, potassium, iron, manganese, zinc, and copper, which might be ascribed to the higher nutrient content of the rain tree litter (Table 5). However, the lower nutrient concentration in vermicompost produced from paddy straw wasted mushroom compost

might have been attributed to nutrient absorption/extraction by the mushroom. Similar outcomes have been published by Chaudhuri et al. (2016), Ritu Nagar et al. [12], and Klomklang et al. (2021). Gaur and Singh [14] reported that supplementing final compost with phosphate solubilizers, nitrogen fixers, and cellulose-degrading microorganisms is a promising strategy. Jadhav et al. [15] also studied nutrient enrichment in vermicompost.

Microbial use of the carbon in the organic matter caused a drop in carbon during the vermicomposting phase. In accordance with Ansari and Sukhraj [16], earthworms alter the substrate conditions by fragmenting it, hence increasing the surface area accessible to microbial action. Vermicompost made completely from rain tree litter indicated greater quantities of additional nutrient enrichment, which may have originated from the higher nutrient concentration in the litter or rain tree leaves.

Additionally, the inclusion of mucus and nitrogenase enzymes from vermicasts, which encourage microbial supported mineralization through the disintegration of earthworm tissues, might have resulted in an increase in nitrogen in vermicompost. Jaikishun et al. [17] additionally published results that were similar.

**Table 4. Characterization of vermicompost as influenced by various substrates**

Treatment	Days required for vermicompost	pH	EC (dSm <sup>-1</sup> )	Organic matter (%)	C:N Ratio
25% RTL +75% PSSMC	63	6.78	1.55	27.85	16.19
50% RTL +50% PSSMC	59	7.20	2.00	21.38	9.71
75% RTL +25% PSSMC	58	7.10	2.00	33.84	10.35
100% RTL	54	7.00	2.80	31.00	8.08
100% PSSMC	56	6.65	1.50	21.50	10.68
S.E. + (m)	3.77	0.190	0.174	2.471	1.010
C.D. at 5%	N.S.	N.S.	0.542	7.697	3.140

**Table 5. Nutrient content in vermicompost influenced by different substrates**

Treatment	Macronutrients (%)			Micronutrients (mg kg <sup>-1</sup> )			
	N	P	K	Fe	Mn	Zn	Cu
25% RTL +75% PSSMC	1.08	0.433	0.343	439	105.25	57	15.50
50% RTL +50% PSSMC	1.36	0.465	0.450	559	130.25	113	16.75
75% RTL +25% PSSMC	1.97	0.775	0.605	621	159.18	179	25.25
100% RTL	2.31	1.185	0.863	1072	231.50	254	54.25
100% PSSMC	1.25	0.555	0.350	640	152.00	141	34.5
S.E.+(m)	0.104	0.086	0.082	65.230	16.824	9.314	5.436
C.D. at 5%	0.323	0.269	0.256	204.37	51.645	31.362	16.936

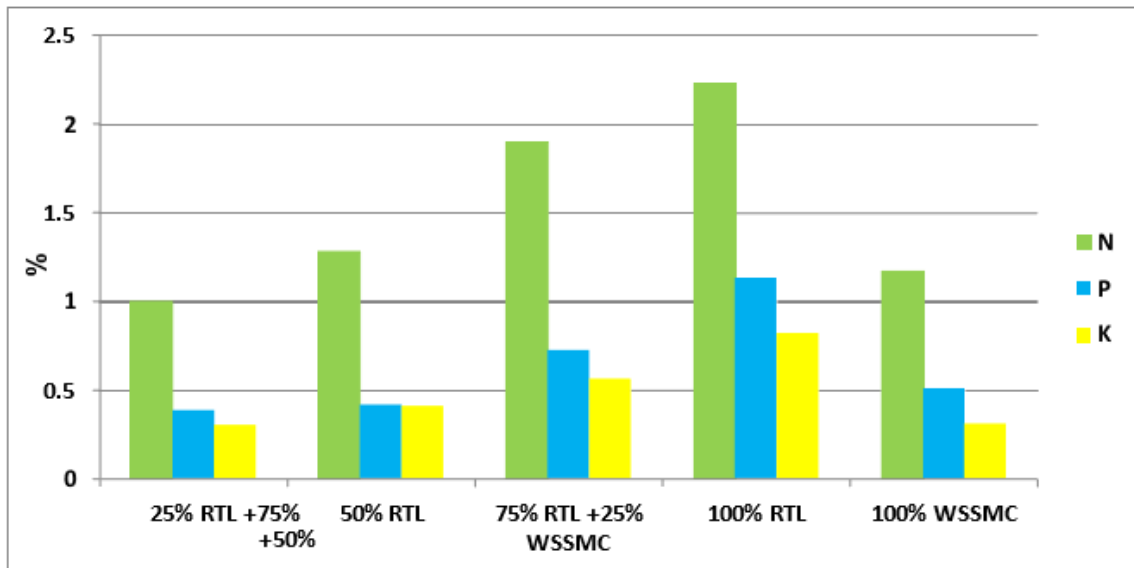


Fig. 4. Nitrogen, phosphorus and potassium content in vermicompost

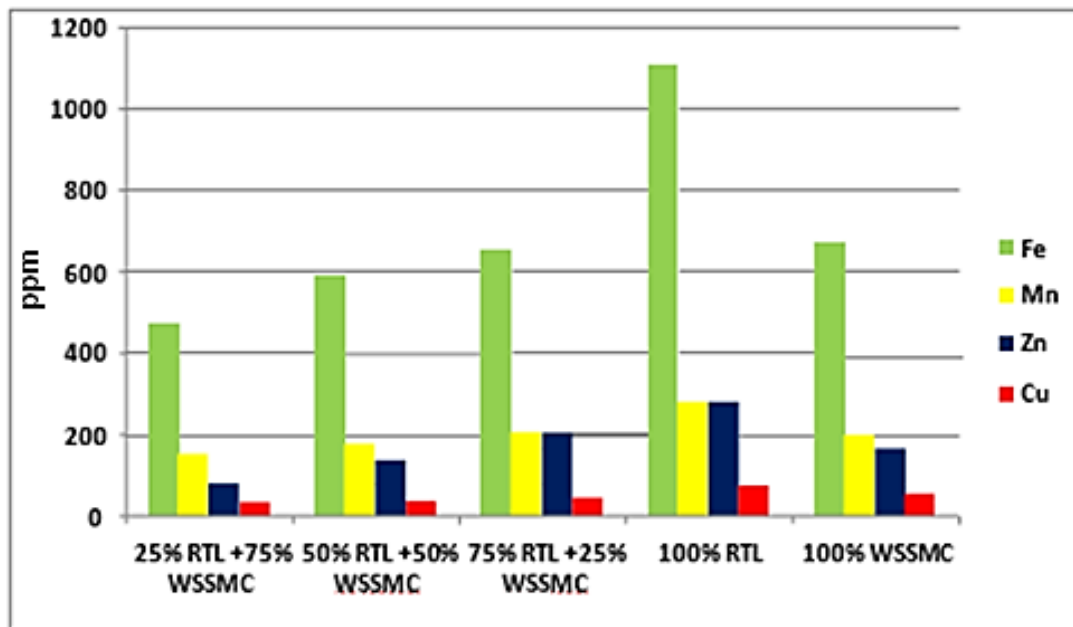


Fig. 5. Iron, manganese, zinc and copper content in in vermicompost

### 3.2 Nutrient Enrichment in Vermiwash as Influenced by Substrates

The colour of vermiwash influenced drastically by using different types of vermicompost used for the preparation of vermiwash. Vermiwash prepared for 100% rain tree litter vermicompost 75%RTL + 25% spent mushroom was observed dark brown in colour than rest of treatments followed by 100 % RTL (Fig. 6). The pH and electrical conductivity, nitrogen, phosphorus,

potassium, iron, manganese and zinc content in vermiwash influenced significantly by different proportions of rain tree litter and paddy straw spent mushroom compost (Tables 6, 7 and 8). However, pH of vermiwash at both harvesting was found non-significant. Numerically vermiwash pH was ranged between 6.73 to 7.50 and 6.40 to 7.75 at first and second harvesting. Electrical conductivity of vermiwash was ranged from 3.43 to 7.20 dSm<sup>-1</sup> for first harvesting and 2.43 to 5.58 dSm<sup>-1</sup> for second harvesting.

Electrical conductivity of first harvested vermiwash was found higher in all the treatments than second harvest. Significantly higher EC of vermiwash was observed at first (7.20 dSm<sup>-1</sup>) and second (5.58 dSm<sup>-1</sup>) harvest when it was prepared by using 100% rain tree litter vermicompost than rest of the treatments. It could be observed from the data that as the proportion of rain tree litter for the preparation of vermicompost increases, the EC also increases. The content of nitrogen, phosphorus and potassium in vermiwash at both the harvesting stage was also significantly affected by the different combinations of raintree litter and paddy straw spent mushroom compost used for vermicompost. Nitrogen, phosphorus and potassium content in vermiwash were ranged from 0.21 to 0.65 and 0.20 to 0.33 %, 0.14 to 0.33 and 0.10 to 0.27% and 0.06 to 0.27 and 0.05 to 0.23% at first and second harvest respectively. Vermiwash by using 100% rain tree litter reported significantly higher nitrogen (0.65 and 0.51%), phosphorus (0.33 and 0.27%) and potassium (0.27 and 0.23%) content at both harvest but higher content was in first harvest. While lower content of nitrogen (0.21 and 0.20%), phosphorus (0.14 and 0.10%) and potassium (0.06 and 0.05%) was observed when 25% RTL +75% PSSMC was used for vermiwash preparation.

Decomposition rate of rain tree litter and paddy straw spent mushroom compost by microbial activity resulting in the production of CO<sub>2</sub> and organic acids which reflected in the reduction of pH. The reduction in pH of vermiwash and vermicompost might be resulted in the higher rate of nitrogen and phosphorus into nitrite/nitrate and phosphorus mineralization. Nutrient enrichment in vermiwash was higher when it was

prepared from 100% rain tree litter/leaves which might be due to the higher nutrient content in rain tree leaves and litter. Further feeding of *Eisenia fetida* on partially decomposed compost and vermicompost prepared from rain tree litter might have released more mucus nitrogenous excretory substances, growth hormones and enzymes from the gut of earthworms might have contributed for nitrogen, phosphorus and potassium enrichment in vermiwash. Similar results was also reported by Hand et al (2008) and Durga and Ramasubramanian [18]. Higher nutrient content in rain tree litter or leaves might have released nutrients elements in vermiwash as well as vermicompost during decomposition. Similar results also quoted by Jadhav et al. [15].

It could be evident from the data presented in Table 8 that, iron, manganese, zinc and copper concentration in vermiwash was noticed more in first harvest than second. Among the micronutrients, the concentration of iron in vermiwash at both harvest was found higher followed by manganese, zinc and copper. Vermiwash prepared by using 100% rain tree litter reported significantly higher iron (16.73 and 12.66 mg kg<sup>-1</sup>), manganese (3.18 and 1.76 mg kg<sup>-1</sup>) and zinc (3.06 and 2.08 mg kg<sup>-1</sup>) content than rest of the treatments. Vermiwash prepared from the vermicompost of 100% raintree litter/leaves reported significantly higher iron content (16.73 and 12.34 mg kg<sup>-1</sup>) at first and second harvest but vermiwash prepared from 75% RTL + 25% PSSMC (12.66 mg kg<sup>-1</sup>) was found statistically at par only at first harvest. Lower concentration of iron, manganese, and zinc was reported in vermiwash prepared from using 25%RTL + 75% PSSMC and 100% PSSMC.

**Table 6. Periodical characterization of vermiwash as influenced by substrates**

Treatments	pH		EC (dSm <sup>-1</sup> )	
	First Harvest	Second harvest	First Harvest	Second harvest
25% RTL +75% PSSMC	6.73	6.40	3.93	2.43
50% RTL +50% PSSMC	6.98	7.05	3.75	3.00
75% RTL +25% PSSMC	7.28	7.08	5.30	3.73
100% RTL	7.50	6.78	7.20	5.58
100% PSSMC	7.00	7.75	3.43	2.53
S.E. + (m)	0.14	0.14	0.33	0.24
C.D. at 5%	N.S.	N.S.	0.98	0.70

**Table 7. Periodical macronutrients status in vermiwash as influenced by different substrates**

Treatments	Nitrogen		Phosphorus		Potassium	
	First Harvest	Second harvest	First Harvest	Second harvest	First Harvest	Second Harvest
25% RTL +75% PSSMC	0.21	0.20	0.14	0.10	0.06	0.05
50% RTL +50% PSSMC	0.45	0.39	0.20	0.12	0.11	0.11
75% RTL +25% PSSMC	0.49	0.38	0.21	0.15	0.14	0.12
100% RTL	0.65	0.51	0.33	0.27	0.27	0.23
100% PSSMC	0.36	0.34	0.21	0.14	0.16	0.13
S.E. + (m)	0.08	0.08	0.02	0.01	0.02	0.02
C.D. at 5%	0.15	0.29	0.08	0.05	0.08	0.07



**Fig. 6. Vermiwash (first harvest) from different substrates**

**Table 8. Periodical micronutrients status in vermiwash as influenced by substrates**

Treatments	Fe(mg kg <sup>-1</sup> )		Manganese (mg kg <sup>-1</sup> )		Zinc (mg kg <sup>-1</sup> )		Copper (mg kg <sup>-1</sup> )	
	First Harvest	Second harvest	First Harvest	Second harvest	First Harvest	Second harvest	First Harvest	Second harvest
25% RTL+75% PSSMC	6.27	4.31	0.55	0.27	0.33	0.16	Trace	Trace
50% RTL+50% PSSMC	7.88	4.77	0.94	0.29	1.17	0.33	Trace	Trace
75% RTL+25% PSSMC	12.66	8.81	2.07	0.89	1.76	0.98	0.45	0.17
100% RTL	16.73	12.34	3.18	1.76	3.06	2.08	1.05	0.45
100% PSSMC	5.65	4.05	0.54	1.02	1.82	1.09	0.13	Trace
S.E. + (m)	1.39	1.11	0.27	0.14	0.24	0.22	--	--
C.D. at 5%	4.11	3.30	0.79	0.42	0.72	0.65	--	--

#### 4. CONCLUSIONS

Data revealed that raintree litter waste/leaves was found suitable organic matter for nutrient enrichment in vermicompost by using earthworm species *Eisenia fetida* than that of paddy straw spent mushroom compost. Further the vermicompost prepared by using rain tree litter waste was also found superior for getting nutrient rich vermiwash. It could be concluded from this experiment that raintree litter/leaves could be a good nutrient source enriching vermicompost and vermiwash rather than burning in open air. This study can be converted into a start-up with HDPE vermibeds and plastic drums of 200 liter for the in-situ production of nutrient rich vermicompost and vermiwash.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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