Influence of Different Substrates on the Nutrient Composition of Vermicompost and Vermiwash.

ABSTRACT

The present study was conducted to evaluate the effect of different substrates on the nutrient composition of vermicompost and vermiwash at DivisionofSoilScience,CollegeofAgriculture,Puneduring2022-23. High density polyethylene beds of 12X4X2feet size wereusedforproductionof vermicompost. While 200 liter capacity plastic barrels were employed for vermiwash preparation.Therewerefivetreatments of substrate combination like 25%raintreelitter(RTL) +75%paddystrawspentmushroomcompost (PSSMC); 50%tree litter+50% paddy straw spent mushroom compost (PSSMC); 75% treelitter+25%paddystrawspentmushroomcompost(PSSMC);100%raintreelitter,100%paddystrawspent 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 barrelsof above capacity were used for vermiwash by using vermicompostprepared from different substrate combinations. The harvesting and sampling of vermiwash was done induplicate for first and second harvest.

Results showed that pH, EC, organic matter, C: N ratio,totalnitrogen,phosphorus,potassium,iron,zinc,manganese,copperinvermicompostweresignificantly influenced by different proportions of rain tree litter and paddy straw spent mushroomcompost.C: N ratio of vermicompost prepared by using rain tree litter and paddy straw spentmushroomcompostwasrangedbetween9.02and14.26.Significantlyhighertotalnitrogen(2.31%),phosphorus (1.185%), potassium (0.863%), iron (1072mgkg^{-1}), manganese (231.50mgkg^{-1}), zinc (254mgkg^{-1})and copper (54.25mgkg^{-1}) were noted in vermicompost from 100% raintreelitter.Significantly high EC (totalsolublesalts) at first and second harvest of vermiwash was reported when 100%raintreelitter compost and vermicompost as substrate used. Further, vermiwashpreparedbyusingvermicompostreportedsignificantly higher nitrogen (0.65 and 0.51%), phosphorus (0.33 and 0.27%) and potassium (0.27and 0.23%) content at both harvest respectively but higher content was in first harvest. Vermiwashprepared from 100% raintree litter vermicompost reported significantly higher Fe, Mn, Zn and Cucontentat both harvestingstage.

Keywords: Raintreelitterwaste,spentmushroomcompost,vermicompostandvermiwash

Soil fertility decline over the globe is one of the major cause for decreasing nutrient use efficiencyand crop productivity. Health and quality of soil deteriorating consistently due to soil erosion, lessuse of organic manures, injudicious use of irrigation water and fertilizers, mono-cropping, no soiltesting, poor crop management, reluctant for green manuring crops etc. are the major causes fordeclining soil fertility resulted in less nutrient use efficiency. In order to improve health and qualityof 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 havehigh 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 earthwormsharbor wide ranges of microorganisms, enzymes, hormones, etc., these half-digested substratesdecompose rapidly and are transformed into a form of vermicompost within a short time (Edwardsand 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 conversionsduring degradation of organic matter are carriedout via enzymatic digestion, enrichment by nutrient excrement, and transport of organic andinorganicmaterials.The vermicast is mixed with mucus secretion ofthegutwall,andofthemicrobesandtransformedintovermicompost(EdwardsandLofty1972).Thedegradation processcontinuesevenafterthereleaseofthecastbytheearthworms with microorganisms.Thestudiesontheeffectofvermicompostingonsomecomponentsoforganicwasteshowed that vermicompost enhances degree of polymerization of humic substances along with adecrease of ammonium N and an increase of nitric N (Cegarra et al. 1992). The plant growthregulatorsandotherplantgrowthinfluencingmaterials,thatis,auxins,cytokinins,humicsubstances, etc.,producedbymicroorganismshavebeenreported fromvermicompost(Atiyehetal. 2002).

Liquid vermiwash is a natural product formed by vermicomposting of organic matter from richpopulationofearthworms, vermicastandvermicompost.Thecharacterizationofvermiwashanditsqualitydepends onmature of organic matter used during decomposition and vermicomposting. Vermiwash contains hormone,mucous,enzyme,vitamins,proteins,differentmacroand micronutrients,andalargenumberofmicrobes.Ascomparedtoapplicationofsolidvermicompost,itsliquid form(vermiwash)ismoresuitable due to its bioavailability to reach quickly to targeted area around the roots of plants (Gudetaet 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 productsof earthworm secretions, the worm coelomic fluid oozing through dorsal pores, mucus, enzymessecretedbyworm&microorganisms,plantnutrients,vitamins&plantgrowthpromotingsubstances.Italsocontainsplantgrowthhormones(auxin&cytokinin)andnitratefixingbacteriaandphosphorussolubilizingbacteria.
Enrichment of compost or vermicompost by using locally available nutrient rich organic matter likeraintreelitteravailableabundantlycanbeusedefficientlyfornutrientenrichment.Itsleavesandtwigscontain substantial amounts of N, P, K, S andother micronutrients.Raintreeleaves canbeusedinsoilas greenorbrownmanuretoincreasesoil and crop productivity (Haque *et.al.*, 1999). Higher nitrogen content in the rain tree litter rangesfrom1.88to2.25whilephosphoruswas0.8to1.1%andpotassiumtothetuneof1%canbesuitabilityusedfornutrient enrichment(Unchalika*et al.,*2021)and (Ritu Nagar*et al.,*2017).

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 compostis 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.

MATERIALANDMETHODS

The experiment was carried out to study enrichment of vermicompost and vermiwash by using raintree litter and mushroom spent compostatVermicompostYardofDivision of Soil Science, College of Agriculture, Pune during 2021-22. The treatment consisted various proportions of raintree 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(Figure 2) were used for this study. The five substratecombinations*viz.*25%raintreelitter(RTL)+75%paddystrawspentmushroomcompost(PSSMC),50%treelitter +50%paddystrawspent mushroomcompost(PSSMC), 75%treelitter +25%paddystraw spent mushroom compost (PSSMC), 100% rain tree litter, 100% paddy straw spent mushroomcompost(PSSMC) werestudied incompletelyrandomizedblock designreplicated fourtimes.

Methodforpreparationofvermicompost:

Total20HDPEvermibedswereinstalledbyfixingsixteenbamboosticksof2.5feetheight.(Figure 1). The essential quantity of rain tree litter was collected from the campus of College whilepaddyspentmushroomcompost(PSSMC)wasprocuredfromAICRPonMushroom 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 (Figure 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 byA.O.A.C (2012) and presented in Table 2.

Methodfor preparationof vermiwash:

Plasticdrumsof200litrecapacityalongwithopen/close(on/off)tapfittedat4inchfrombottom(forharvesting of vermiwash) were used for vermiwash preparation **(Figure 3)**. The ten plastic drumswere filled with the layering adopted as stated in table 3. Two vermiwash drums were kept for onetreatment and quadruplicate sampling of vermiwash from each drum was carried out for assessingcharacterization and nutrient composition. The treatment wise rain tree litter and paddy straw spentmushroomcompostwereallowedtopartiallydegradefor45daysandthereafterusedforvermicomposting.Vermicompostpreparedfromvariousproportionsofraintreelitterandpaddystrawspent mushroom compost was used for extracting vermiwash. Bricks pieces, gravel, coarse and finesand,plasticnet,cowdung,partiallydecomposedcompostandvermicompostofrespectivetreatment,earthwormsandgunnybagswereusedfor fillingthe vermiwash drum.

The vermiwash drums were filled layer wise **(Table 3)**. After filling vermiwash drums, they wereallowedforincubationupto15days**(Figure2)**.Themoisturecontentwasmaintained50-55percentin the vermiwash drums. After 15 days of incubation, 10 litres of water added in each drum andallowed to saturate for 48 to 50 hours for incubation and then treatment wise vermiwash harvested.Harvested vermiwash was analysed for characterization and nutrient composition by followingstandardmethods. (A.O.A.C 2012)

Table1Quantityoforganicmatterusedineachbed

Treatmentno.	organicmatter proportion	Organic matter quantity per treatment(kg)	
		Raintree litter	Paddystraw spent mushroomcompost
T_1	25%RTL+75%PSSMC	1000	3000
T_2	50%RTL+50%PSSMC	2000	2000
T_3	75%RTL+25%PSSMC	3000	1000
T_4	100%RTL	4000	-
T_5	100%PSSMC	-	4000

Table2Nutrient content in raintreelitterandpaddystrawspentmushroomcompost

Sr.no.	Parameter	Raintreelitter	Paddystraw mushroomcompost
1	pH(1:10)	7.6	7.3
2	ECdSm^{-1}(1:10)	1.22	0.44
3	Organiccarbon(%)	118	41
4	N(%)	2.08	0.66
5	P(%)	0.98	0.45
6	K(%)	0.79	0.38
7	Fe(mgkg^{-1})	186	54
8	Mn (mgkg^{-1})	78	27
9	Zn(mgkg^{-1})	69	22
10	Cu (mgkg^{-1})	29	21
11	C:Nratio	56.73	62.21
12	C:P ratio	120.40	91.11

Table3Layering in thevermiwashdrum

First Layer(frombottom) (15-20cmThick)	Brickspieces 75-100nos.
SecondLayer (10-15cmThick)	Coarsesand 25kg
ThirdLayer(5-10cm)	FineSand(size2-3cm)25kg
Fourth Layer(15-25cm)	Partiallydecomposedcompost(100to150kg)mixed withcowdung (15-20daysold)50to 60 kg
Fifth Layer(5To10cm)	Vermicompostapproximately40 to80 kg
SixthLayer	Earthwormsofspecies(*Eiseniafetida*)4-5kgor 1000to 1500numbers.
SeventhLayer	Vermicompost+cowdung(15-20daysold)in50:50 proportion50 kg
EighthLayer	Partiallydecomposedcompost(100to150kg)mixed withcowdung (15-20daysold)50to 60 kg
NinthLayer	Vermicompost(40to80kg)
TenthLayer	Wetgunnybags

Figure1 Earthwormsofspecies*Eisenia fetida*

Figure2HDPE vemibeds(12X4X2)

Figure3Vermiwashunitwith200litreplasticdrumsRE

SULTAND DISCUSSION

Nutrientenrichmentinvermicompostasinfluencedbyraintreelitterwaste

The nutrient content in vermicompost as influenced by various substrates in different proportions was presented. **(Table4 and 5 and Figure 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 co mpost.The EC of vermicompost fluctuated between 1.55 to 2.80 dSm^{-1}. Vermicompost produced from 100% rain tree litter having far greater EC (2.80 dSm^{1}), followed closely by 50% rain tree litter and 50% paddy straw spent mushroom comp ost.A lower EC (1.55 dSm-1) 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_2 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-1, 105.25 to 231.50 mg kg-1, 57 to 254 mg kg-1, and 15.50 to 54.25 mg kg-1, respectively.

The data showed that the vermicompost produced using 100% rain tree litter contains considerably higher concentrations of Fe (1072 mg kg^{-1}), Mn (231.50 mg kg^{-1}), Zn (254 mg kg^{-1}), and Cu (54.25 mg kg^{-1}). However, vermicompost made from rice straw wasted mushroom compost possesses a lower content of Fe (640 mg kg^{-1}), Mn (152.00 mg kg^{-1}), Zn (141 mg kg^{-1}), and Cu (34.50 mg kg^{-1}).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 no. 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. (2017), and Klomklang et al. (2021). Gaur and Singh (1993) reported that supplementing final compost with phosphate solubilizers, nitrogen fixers, and cellulose-degrading microorganisms is a promising strategy. Jadhav *et al.*, (2023) 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 (2010), 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. (2014) additionally published results that were similar.

Table4.Vermicompost characteristics as influenced by various substrates and its combinations

Treatment	Daysrequiredfor vermicompost	pH	EC (dSm^{-1})	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.$\pm$(m)	3.77	0.190	0.174	2.471	1.010
C.D.at5%	N.S.	N.S.	0.542	7.697	3.140

Table5.Nutrient content of vermicompost influenced by different substrates

Treatment	Macronutrients(%)			Micronutrients (mgkg^{-1})			
	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.$\pm$(m)	0.104	0.086	0.082	65.230	16.824	9.314	5.436
C.D.at5%	0.323	0.269	0.256	204.37	51.645	31.362	16.936

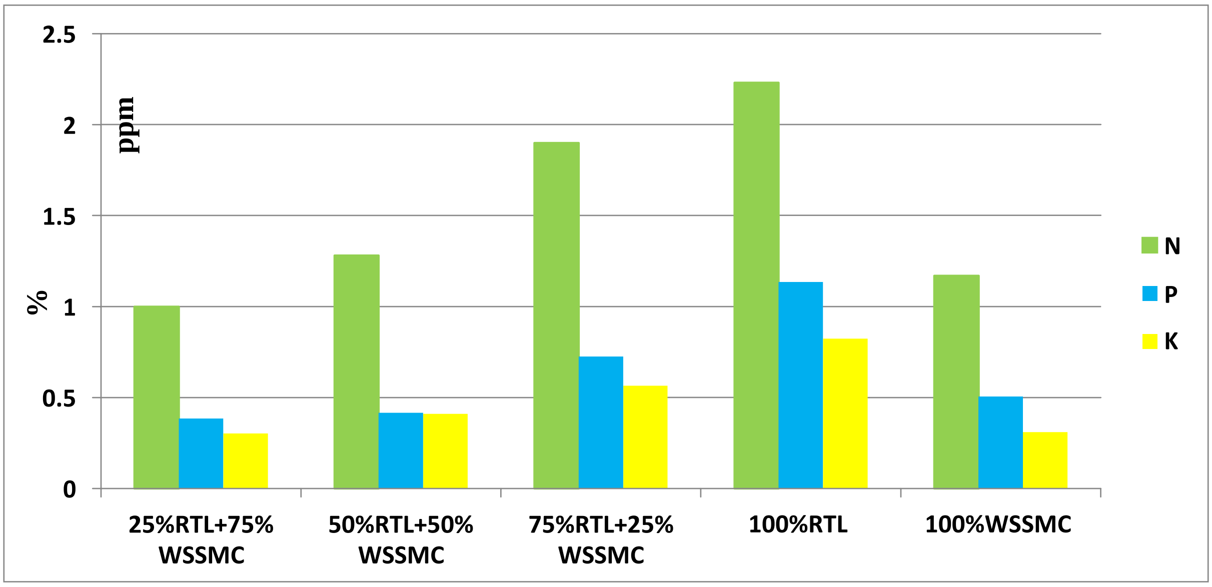

Figure4Nitrogen,phosphorusand potassiumcontentinvermicompost

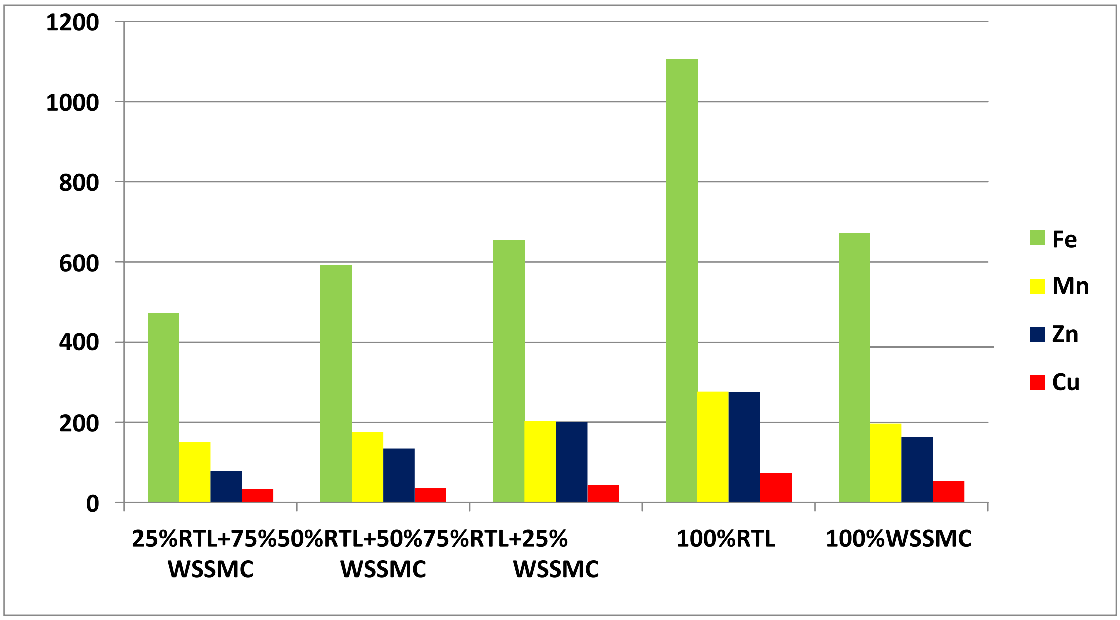

Figure5Iron, manganese,zincandcoppercontentininvermicompost

Nutrientenrichmentinvermiwashasinfluencedbydifferent substrates

Thecolourofvermiwashinfluenceddrasticallybyusingdifferenttypesofvermicompostusedfor the preparation of vermiwash. Vermiwash prepared for 100% rain tree litter vermicompost75%RTL+25%spentmushroomwasobserveddarkincolourthanrestoftreatments**(Figure6)**.ThepHandelectricalconductivity,nitrogen,phosphorus,potassium,iron,manganeseandzinccontentinvermiwash influenced significantly by different proportions of rain tree litter and paddy straw spentmushroom compost **(Table 6, 7 and 8)**. However, pH of vermiwash at both harvesting was foundnonsignificant.NumericallyvermiwashpHwasrangedbetween6.73to7.50and6.40to7.75atfirstandsecond harvesting.Electrical conductivityof vermiwashwasrangedfrom3.43to7.20dSm^{-1}forfirstharvestingand2.43to5.58dSm^{-1}forsecondharvesting.Electricalconductivityoffirstharvestedvermiwash was found higher in all the treatments than second harvest.Significantly higher EC ofvermiwash was observed at first (7.20 dSm^{-1}) and second (5.58 dSm^{-1}) harvest when it was preparedbyusing100%raintreelittervermicompostthanrestofthetreatments.Itcouldbeobservedfromthedata that as the proportion of rain tree litter for the preparation of vermicompost increases, the ECalsoincreases.Thecontentofnitrogen,phosphorusandpotassiuminvermiwashatboththeharvesting stage was also significantly affected by the different combinations of raintree litter andpaddy straw spent mushroom compost used for vermicompost. Nitrogen, phosphorus and potassiumcontent in vermiwash were ranged from 0.21 to 0.65 and 0.20 to 0.33 %, 0.14 to 0.33 and 0.10 to0.27% and 0.06 to 0.27 and 0.05 to 0.23% at first and second harvest respectively. Vermiwash byusing100%raintreelitterreportedsignificantlyhighernitrogen(0.65and0.51%),phosphorus(0.33and 0.27%) and potassium (0.27 and 0.23%) content at both harvest but higher content was in firstharvest. While lower content of nitrogen (0.21 and 0.20%), phosphorus (0.14 and 0.10%) andpotassium (0.06 and 0.05%) was observed when 25% RTL +75% PSSMC was used for vermiwashpreparation.

Decompositionrateofraintreelitterandpaddystrawspentmushroomcompostbymicrobialactivityresulting in the production of $CO_2$and organic acids which reflected in the reduction of pH. ThereductioninpHofvermiwashandvermicompostmightberesultedinthehigherrateofnitrogenandphosphorusintonitrite/nitrateandphosphorusmineralization.Nutrientenrichmentinvermiwashwashigher whenitwaspreparedfrom100%raintreelitter/leaveswhichmightbeduetothehighernutrientcontent in rain tree leaves and litter. Further feeding of *Eisenia fetida*on partially decomposedcompostandvermicompostpreparedfromraintreelittermighthavereleasedmoremucusnitrogenous excretory substances, growth hormones and enzymes from the gut of earthworms mighthave contributed for nitrogen, phosphorus and potassium enrichment in vermiwash. Similar resultswas also reported by Hand *et al* (2008) and Durga and Ramasubramanian (2015). Higher nutrientcontent in rain tree litter or leaves might have released nutrients elements in vermiwash as well asvermicompost duringdecomposition. Similar results also quoted by Jadhav *et al* (2023).

It could be evident from the data presented in table 8 that, iron, manganese, zinc and copperconcentrationinvermiwashwasnoticedmoreinfirstharvestthansecond.Amongthemicronutrients,theconcentrationofironinvermiwashatbothharvestwasfoundhigherfollowedbymanganese,zincand copper. Vermiwash prepared by using 100% rain tree litter reported significantly higher iron(16.73 and 12.66 mg kg^{-1}), manganese (3.18 and 1.76 mg kg^{-1}) and zinc (3.06 and 2.08 mg kg^{-1})content than rest of the treatments. Vermiwash prepared from the vermicompost of 100%

raintreelitter/leaves reported significantly higher iron content (16.73 and 12.34 mg kg^{-1}) at first and secondharvestbutvermiwashpreparedfrom75%RTL+25%PSSMC(12.66mgkg^{-1})wasfoundstatisticallyatparonlyatfirstharvest.Lowerconcentrationofiron,manganese,andzincwasreportedinvermiwash preparedfrom using25%RTL+75%PSSMC and 100%PSSMC.

Conclusions

Data revealed that raintree litter waste/leaves was found suitable organic matter for nutrientenrichmentinvermicompostbyusingearthwormspecies*Eiseniafetida*thanthatofpaddystrawspentmushroomcompost.Furtherthevermicompostpreparedbyusingraintreelitterwastewasalsofoundsuperiorforgettingnutrientrichvermiwash.

Itcouldbeconcludedfromthisexperimentthatraintreelitter/leaves could be a good nutrient source enriching vermicompost and vermiwash rather thanburning in open air.This study can be converted into a start-up with HDPE vermibeds and plasticdrumsof200 liter forthein-situproduction ofnutrientrich vermicompostandvermiwash.

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Table 6.Periodical characteristics of vermiwash as influenced by various substrates

Treatments	pH		EC (dSm^{-1})	
	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.at5%	N.S.	N.S.	0.98	0.70

Table 7. Periodical macronutrientsstatus 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.at5%	0.15	0.29	0.08	0.05	0.08	0.07

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

Treatments	Fe ($mgkg^{-1}$)		Manganese ($mgkg^{-1}$)		Zinc ($mgkg^{-1}$)		Copper ($mgkg^{-1}$)	
	First Harvest	Second harvest	First Harvest	Second harvest	First Harvest	Second harvest	FirstHarvest	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.at5%	4.11	3.30	0.79	0.42	0.72	0.65	--	--

Figure6Vermiwash(firstharvest)fromdifferenttreatments.

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