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Nutrient composition of vermicompost as influenced by rain tree litter (*Samanea saman*) and paddy spent mushroom compost

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Abstract
An experiment was conducted to assess the nutrient composition of vermicompost as influenced by different organic substrates *viz.*, rain tree litter and paddy straw spent mushroom compost. This experiment was undertaken at Vermicompost Yard of Division of Soil Science, College of Agriculture, Pune during 2021-22. Different proportion of rain tree litter and paddy straw spent mushroom compost were used for the production of vermicompost by using earthworm species *Eisenia fetida*. HDPE Vermibeds of size 12 X 4 X 2 feet were used for this study. There were 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) made for the preparation of vermicompost and replicated four times in completely randomized block design.
The objective of this experiment is to assess nutrient composition of vermicompost prepared by using different combinations of rain tree litter and paddy straw spent mushroom compost. It can be reveal from the data that pH (1:10), EC (1:10), organic matter, C:N ratio, total nitrogen, phosphorus, potassium, iron, zinc, manganese, copper were significantly influenced by different combinations of rain tree litter and paddy straw spent mushroom compost. The EC of vermicompost was ranged between 1.47 to 2.81 dSm^{-1}. Vermicompost prepared from 100% rain tree litter reported significantly higher EC (2.81 dSm^{-1}) which was closely followed by 50% rain tree litter and 50% paddy straw spent mushroom compost. Lower EC (1.47 dSm^{-1}) was reported with 100% paddy straw spent mushroom compost. The C:N ratio of these vermicompost prepared by using rain tree litter and paddy straw spent mushroom compost was ranged between 9.02 to 14.26. 50% rain tree litter and 50% paddy straw spent mushroom compost was reported significantly lower C:N ratio 8.83% which was closely and statistically at par with 100% rain tree litter (9.02) and 75% rain tree litter and 25% paddy straw spent mushroom compost (11.72). Macronutrients like nitrogen (2.23%), phosphorus (1.13%) and potassium (0.823%) was found significantly higher in vermicompost prepared by using 100% rain tree litter. However micronutrients like iron (1150ppm), manganese (276.5ppm), zinc (276ppm) and copper (73.25ppm) were also found significantly superior than rest of the treatment. It could be concluded from this experiment that rain tree litter from various campuses can be good source of organic matter with nutrients for preparation of vermicompost by using *Eisenia fetida* species of earthworms.

Keywords: Vermicompost, rain tree litter, paddy straw spent mushroom compost, *Eisenia fetida*

Introduction
Consistent reduction of organic matter content in the Indian soils creating alarming situation for deterioration of soil quality, health and its functions. Many physical, chemical and biological properties of soils are also negatively affected due to the reduction in soil organic matter. Non availability of organic matter causing reduction in beneficial micro flora in the rhizosphere ecosystem. Reducing nutrient use efficiency through applied chemical fertilizers due to less organic matter content in the soil.
The soil loss and declining its fertility is a major concern over the world. Continuous cropping, Imbalanced use of fertilizers, no addition of organic matter in soil, less use of organic manures, no soil and water testing, mono-cropping, injudicious use of irrigation water, nutrient mining, multi-nutrient deficiencies on plants resulted in consistent reduction in soil biological flora and fauna. This resulted in reduced crop production and productivity. Under such alarming situation it is necessary to look for alternatives which are effective and eco-friendly for the maintenance of soil fertility and resilience of soil. In order to optimize soil fertility it is necessary to adopt intelligent and integrated management of nutrient sources from chemical

fertilizers, organic manures and bio fertilizers. Among various organic manures, vermicompost is an aerobic composting method by using earthworms. It is one of the easiest methods to recycle agricultural waste or tree litter waste into good quality compost. Earthworms consume biomass and excrete it in digested form called warm cast, it is also called as black gold. The vermin cast and compost is rich in nutrients, growth promoting substances, beneficial micro flora along with components of inhibiting pathogenic microbes. In the urban areas many government and private organizations have various trees particularly rain trees in their campuses. The litter falls every year in these campuses is not used for either composting due to the constraints in the collection, transport and technical expertise. At present this litter is burned on site which increases CO_2 in the air. The rain trees in College of Agriculture, Pune campus, which are over 25-30 meters high and 125 -150 years old, produce large quantities of tree litter. 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% (Unchalika *et al.*, 2021) [6] and (Ritu Nagar *et al.*, 2017) [4]. Further significant quantity of mushroom spent compost is also generated in the campus after the harvest of mushrooms.

The objectives of this study was to optimize the suitable proportion of rain tree litter and mushroom spent compost for the production of nutrient rich vermicompost by using earthworms of species *Eisenia fetida*. Therefore the study was undertaken to assess nutrient composition of vermicompost as influenced by rain tree litter and mushroom spent compost.

Material and methods

An experiment was conducted to assess the nutrient composition of vermicompost as influenced by different organic substrates *viz.*, rain tree litter and paddy straw spent mushroom compost. This experiment was undertaken at Vermicompost Yard of Division of Soil Science, College of Agriculture, Pune during 2021-22. Different proportion of rain tree litter and paddy straw spent mushroom compost was used for the production of vermicompost. HDPE Vermi beds of size 12 X 4 X 2 feet were used for this study. There were 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) made for the preparation of vermicompost and replicated four times in completely randomized block design.

Method for preparation of vermicompost

There were total 20 HDPE vermibeds were installed by using sixteen bamboo sticks with 2.5 feet height. The required quantity of rain tree litter was collected from campus of College of Agriculture, Pune. Paddy spent mushroom compost (PSSMC) was procured from AICRP on Mushroom Project, College of Agriculture, Pune. Rain tree litter and paddy straw spent mushroom compost was mixed thoroughly on dry weight basis as per the treatment. Total quantity of organic matter either from rain tree litter or paddy straw spent mushroom compost was kept 3000 kg in each bed. This treatment wise rain tree litter and paddy straw spent mushroom compost were allowed to partially degrade for 45 days and thereafter used for vermicomposting. The vermibeds were filled layer wise *viz* first layer of 10 -15 cm thick was given with undecomposed fresh rain tree litter and paddy straw spent mushroom compost. Second layer of similar thickness was given with partially decomposed organic waste as per their proportion and treatment. Third layer was given uniformly over second layer with cow dung slurry (40 lit. cow dung + 100 lit. water + 1 kg decomposing culture). Similar layering was carried out for filling complete HDPE beds. There after 3 kg earthworms of species *Eisenia fetida* were released in each vermin bed. Moisture content 50-55% was maintained till harvesting of treatment wise vermicompost. The initial composition of rain tree litter and paddy straw spent mushroom compost was carried out according to the standard methods given by A.O.A.C (2012) [1].

Table 1: Characterization of rain tree litter and paddy straw spent mushroom compost

Sr. no.	Parameter	Rain tree litter	Paddy straw spent mushroom compost
1	pH (1:10)	7.9	7.1
2	EC dSm^{-1}(1:10)	0.80	0.35
3	Organic carbon (%)	102	32
4	N (%)	1.98	0.77
5	P (%)	0.98	0.45
6	K (%)	0.57	0.28
7	Fe (ppm)	150	65
8	Mn (ppm)	80	35
9	Zn (ppm)	65	28
10	Cu (ppm)	32	18
11	C:N	51	41

Table 2: Treatment wise quantity of organic matter used in each bed

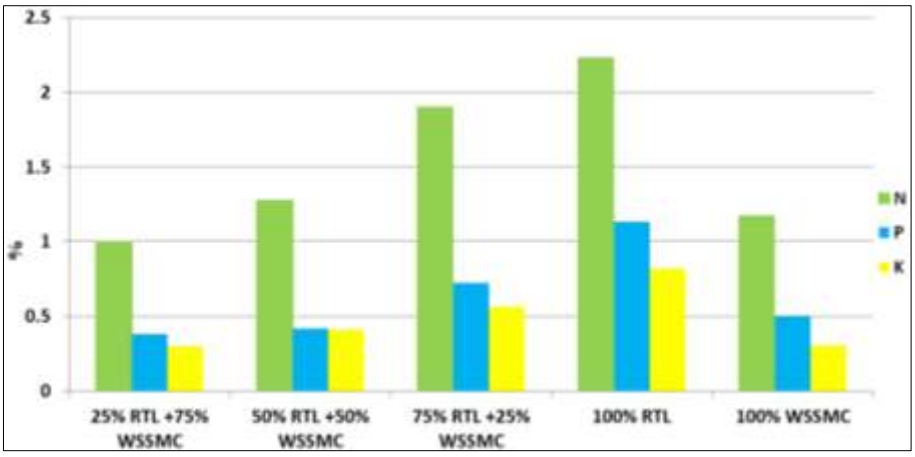
Treatment No.	Proportion of organic matter	Quantity of organic matter on dry weight basis (kg)	
		Rain tree litter	Paddy straw spent mushroom compost
1	25% RTL +75% PSSMC	750	2250
2	50% RTL +50% PSSMC	1500	1500
3	75% RTL +25% PSSMC	2250	750
4	100% RTL	3000	-
5	100% PSSMC	-	3000

Table 3: Characteristics of vermicompost

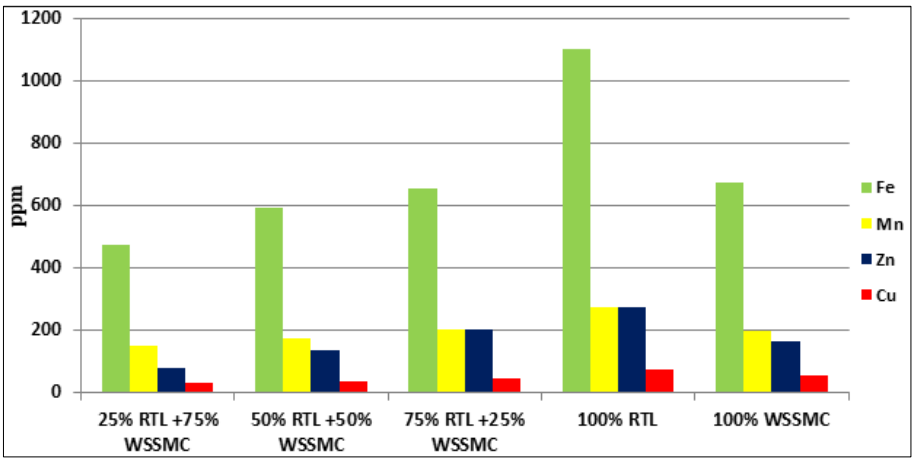
Treatment	Days required for vermicompost	pH	EC (dSm^{-1})	Organic matter (%)	C:N ratio
25% RTL +75% PSSMC	64	6.77	1.56	24.31	14.26
50% RTL +50% PSSMC	58	7.17	2.10	18.98	8.83
75% RTL +25% PSSMC	60	7.10	1.97	30.86	9.68
100% RTL	55	7.02	2.81	28.90	11.72
100% PSSMC	54	6.65	1.47	17.77	9.02
S.E.(m)	3.77	0.190	0.174	2.471	1.010
C.D. at 5%	N.S.	N.S.	0.542	7.697	3.140

Table 4: Nutrient composition of vermicompost

Treatment	Macronutrients (%)			Micronutrients (ppm)			
	N	P	K	Fe	Mn	Zn	Cu
25% RTL +75% PSSMC	1.00	0.383	0.303	472	150.25	79	33.50
50% RTL +50% PSSMC	1.28	0.415	0.410	592	175.25	135	35.75
75% RTL +25% PSSMC	1.90	0.725	0.565	654	204.18	201	44.25
100% RTL	2.23	1.135	0.823	1105	276.50	276	73.25
100% PSSMC	1.17	0.505	0.310	673	197.00	163	53.50
S.E.(m)	0.104	0.086	0.082	75.230	18.824	12.314	5.436
C.D. at 5%	0.323	0.269	0.256	234.37	58.645	38.362	16.936



a. Macronutrients (%)



b. Micronutrients (%)

Fig 1: Nutrient composition of vermicompost

Result and Discussion

The nutrient composition of vermicompost prepared by using rain tree litter and paddy straw spent mushroom compost in different proportions was presented in (table 4 and graph 1).

The chemical properties like EC, organic matter and C:N ratio of vermicompost was found significantly affected by the rain tree litter and paddy straw spent mushroom compost. Non-significant results were reported for days required for vermicompost by using different combinations of rain tree litter and paddy straw spent mushroom compost. Almost similar period in days were required for the production of vermicompost by using 100% rain tree litter (55 days) and 100% paddy straw spent mushroom compost (54 days). Use of rain tree litter and paddy straw spent mushroom compost in

different proportion reported non-significant results for the pH of vermicompost. Numerically lowest pH (6.65) was reported in the vermicompost prepared by using 100% paddy straw spent mushroom compost while higher pH was recorded with 50% rain tree litter (RTL) and 50% paddy straw spent mushroom compost (PSSMC). EC, organic matter and C:N ratio of vermicompost was significantly influenced by rain tree litter and paddy straw spent mushroom compost. The EC of vermicompost was ranged between 1.47 to 2.81 dSm^{-1}. Vermicompost prepared from 100% rain tree litter reported significantly higher EC (2.81 dSm^{-1}) which was closely followed by 50% rain tree litter and 50% paddy straw spent mushroom compost. Lower EC (1.47 dSm^{-1}) was reported with 100% paddy straw spent mushroom compost. Significantly lower organic matter (17.77%) in vermicompost was reported by using 100% paddy straw spent mushroom compost which was found to be at par with 50% rain tree litter and 50% paddy straw spent mushroom compost (18.98%).

The C:N ratio of these vermicompost prepared by using rain tree litter and paddy straw spent mushroom compost was ranged between 9.02 to 14.26. 50% rain tree litter and 50% paddy straw spent mushroom compost was reported significantly lower C:N ratio 8.83% which was closely and statistically at par with 100% rain tree litter (9.02) and 75% rain tree litter and 25% paddy straw spent mushroom compost (11.72).

Rate of decomposition of any organic matter dependents upon total carbon and total nitrogen ratio. The carbon to nitrogen ratio is an important parameter, which will relate the composting reactions to the relative concentrations of essential chemical constituents required for the growth and metabolic reactions of the microbial populations. Compounds such as carbohydrates, in addition to being sources of carbon for the microbial biomass, will generate energy required for the microbial metabolic activity. Nitrogen is an essential component of proteins and amino acids required for the growth of the microbial biomass. Generally, it is recommended that, to maintain and active microbial population during composting, the available carbon to nitrogen ratio should be kept at appropriate levels. Lower ratios will result in losses of nitrogenous compound, while higher ratios will retard the composting process. So in case of rain tree litter, the nitrogen content was higher than that of paddy straw spent mushroom compost that has resulted in lower days were required for rain tree litter vermicompost than rest of the treatment. Further the C:N ratio can be regulated by selecting the most suitable combination of organic matter by using rain tree litter and paddy straw pent mushroom compost. In these experiment vermicomposts prepared by using various combination of organic matter were reported to have less than 30 C:N ratio which indicates good quality of compost and after application in soil rate of mineralization will be high. However lower the C:N ratio, the more rapidly nitrogen will be released into the soil for crop use (Martin., 2007) [2].

Nitrogen, phosphorus and potassium content in vermicompost prepared from various combination of rain tree litter and paddy straw spent mushroom compost were ranged from 1 to 2.23%, 0.383 to 1.135% and 0.303 to 0.832% respectively. Vermicompost prepared from 100% rain tree litter was reported significantly higher nitrogen (2.23%), phosphorus (1.135%) and potassium (0.823%) content. However, lower nutrient content was reported in vermicompost prepared from 25% rain tree litter + 75% paddy straw spent mushroom compost (N:1%, P:0.383% and K:0.303%). It could be observed from the data that as the proportion of rain tree litter increase with paddy straw spent mushroom compost, the nutrient composition in vermicompost also increases. Further magnitude of increase in the enrichment of nutrient was also higher with rain tree litter than that of paddy straw spent mushroom compost.

Metallic micronutrient (*viz.*, Fe, Mn, Zn and Co) content in vermicompost also affected significantly with different substrates and their proportions. Fe, Mn, Zn and Cu concentration in vermicompost was ranged between 472 to 1105 ppm, 150.25 to 276 ppm, 79 to 276 ppm and 33.5 to 77.25 ppm respectively.

It could be notice from the data that significantly higher Fe (1105 ppm), Mn (276 ppm), Zn (276 ppm) and Cu (77.25 ppm) concentration was reported in the vermicompost prepared by using 100% rain tree litter. However lower Fe (472 ppm), Mn (150.25 ppm), Zn (79 ppm), and Cu (33.50 ppm) content was reported in vermicompost prepared by using paddy straw spent mushroom compost.

Higher concentration of nitrogen, phosphorus, potassium, iron, manganese, zinc and copper was reported in the vermicompost prepared by using 100% rain tree litter which might be due to higher content of these nutrients in the rain tree litter (table no.1). However lower nutrient concentration in the vermicompost prepared from paddy straw spent mushroom compost might be due to the absorption /extraction of nutrients by mushroom. Similar results were also reported by P. S. Chaudhuri *et al.*, (2016) [3], Ritu Nagar *et al.*, (2017) [4], U. Klomklang *et al.*, (2021) [5].

Conclusion

It could be concluded from this experiment that vermicompost prepared by using 100% rain tree litter (RTL) along with earthworm of species *Eisenia fetida* was found of good quality than that of paddy straw spent mushroom compost. Further rain tree litter is a good source of organic matter rich in nutrients which is produce in huge amount almost in every public campus that can be converted into nutrient rich vermicompost.

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