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A STUDY ON DECOMPOSITION OF TEMPLE WASTE USING FUNGAL FORMULATIONS AND EVALUATING THE SURVIVAL RATE OF EARTHWORMS

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AUTHORS' CONTRIBUTIONS

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ABSTRACT

Proper management of organic waste is one of the most important problem of human society. Enormous quantity of organic wastes is generated on a daily basis, most of which is thrown in open areas, water bodies (rivers, streams or drainage systems) or on the roads which contaminates the environment. Therefore, pollution free, odor free and disease-free disposal and management of temple waste needs more attention. The present was designed to study the decomposition of temple waste using formulation, evaluation of survivability earthworms and to find out the best possible method of decomposition. A series of six experiments were conducted for the purpose of temple floral waste degradation using different setups (experimental trays) and having different combinations of temple floral waste, cattle dung, leaves and *Trichoderma viride.* First three sets were without *Trichoderma viride* while other three were treated with *Trichoderma viride*. Furthermore, experimental series were accompanied to assess the survival rate of *Eisenia fetida* using different sets and varied combinations of temple floral waste, cattle dung and leaves. However, significantly higher decomposition rate was observed in Set-IV (TW: D+ *T. viride*). Though, highest number of adults, cocoons and juveniles were observed in set-III (TW: D). It was concluded that temple waste alone is not a suitable substrate for vermicomposting and it should be blended with other suitable waste materials such as dung and *Trichoderma viride* in appropriate proportions. Moreover, in temple waste earthworms could not survive due to high amounts of pigmented constituents.

Keywords: Temple waste; vermicomposting; Trichoderma; earthworms; dung.

1. INTRODUCTION

The process of environmental degradation has increased with the advancement in agricultural sector due to the increase in the human population and subsequently its growing needs. In developing countries, the urban population is growing at very fast pace and it is estimated that by the year 2025, the two-third part of the world's population shall start residing in cities [1]. Thus, there will be an increased exploitation of energy subsidies, natural resources and consequently more degradation of the environment. Presently, there is continuous waste generation in urban and rural areas producing undesirable pollutants into the environment and a menace to the health of the community. Environment pollution causes several

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ecological, climatic and biological changes. Studies reported that environmental pollution causes various undesirable changes such as green-house effect, global warming, ozone layer depletion, enhancement of hazardous solar radiations, increase in sea water level, nature's imbalance, soil erosion etc. Around 50 million tons of municipal waste is generated every year in many cities of India [2-4]. Such large quantities of waste being generated has created the challenging issues to its proper disposal [5]. It has been reported that in India around 960 million tons of solid waste is generated annually, from different sources including industrialization by-products, municipal, mining, agricultural and other processes [6]. Flower waste is one of the biggest sources of solid waste materials and it play major contributory role in Municipal Solid Waste (MSW) generation [7]. Mismanagement of temple waste is one of the major causes of environmental pollution. In India, there are many temples which are being visited by a large number of devotees. Lots of people are daily visitors of the temples, mosques and gurudwaras to offer prayers and worship, used to offer floral garlands, agarbatti, fruits, milk, prasaad, dhatura, dhoopbati, coconut, sweets and havan material etc. to the God which is generated in the temple and converted into wastes. Temple waste is a heterogeneous mixture of different materials offered to God and its composition varies in each temple. A huge amount of flower waste is also released from marriage gardens, hotels, houses and other places where they are used for variety of purposes [8]. The environment around the temple area becomes polluted and it creates pollution, foul and unbearable gases which influence human health. Waste generated from temples is mostly organic in nature and constitute about 70% of entire solid waste [9]. In India, the quantity of floral waste generation is 300 million ton per day [10]. Flower waste is believed to be holy residue, which is disparate from other wastes and is thrown away in waterbodies. Generally, flower waste is ignored and constantly deteriorating the environment and different water channels. These waste materials create unbearable foul smell and spread lots of gases which causes various infectious diseases among human beings. However, it was found that temple wastes are the major source of environmental pollution and causes various harmful health diseases. India has more than two million temples. Burning of incense account as an abundant source of large number of particulate matters and cancerous Polycyclic Aromatic Hydrocarbons (PAHs) [11]. This practice produces non-stop smoke because of its long, slow and incomplete combustion. Various studies demonstrated that people subject to such smoke established substantial potential risk for the existence of acute throat and upper respiratory tract irritation [12]. Floral waste is said to account for 16% of the total pollution of the rivers [13]. Excess organic content present in the flowers leads to increased algal blooms production and eutrophication in water bodies when floral waste starts decomposing. Additionally, it may disturb amount of oxygen in the water bodies and cause deaths in aquatic systems. However, floral waste generating at temples is evolving a severe threat to environment and human beings. The current methods of disposal including dumping, releasing in water and burning of waste are not safe and are the cause of pollution foul smells, unhygienic atmosphere and other problems. Therefore, pollution free, odor and disease-free disposal and management of temple waste needs more and more attention and simple and viable methods are to be developed. Hence, it was decided to explore the possibility of management of temple flower waste. The organic nature of the temple flower waste makes it available to various biological management options such as vermicomposting as a substitute of disposal to landfill sites, open dumping or any other environmentally risky and costly waste management alternatives [14, 15]. Therefore, Present study was designed to manage the temple wastes by decomposition method using *Eisenia fetida* and other formulations.

2. MATERIALS AND METHODS

2.1 Study Area

The present study was carried out in the laboratory of Zoology Division, Career Point University, Hamirpur (H.P.) situated at 31.6218394^o N latitude and 76.6227815^o E longitude. A detailed study was conducted in order to manage the disposal problems of temple waste.

2.2 Study Materials

The temple waste was collected from the nearby **"Santoshi Mata Temple"**, Ladraur Hamirpur, Himachal Pradesh. The epigeic earthworm species viz., *Eisenia fetida* was procured from Chaudhary Sarwan Kumar Himachal Pradesh Agricultural University, Palampur. Cattle dung was procured from nearby cow dairy farm Manoh (Hamirpur). Leaves of *Ficus benghalensis* (Banyan tree) were collected from the university campus. *Trichoderma viride* (*T. viride*) formulations were procured from Y.S. Parmar University Nauni. It is a type of fungi and a bio-fungicide which is widely used in agriculture for decomposition of agricultural waste.

2.3 Experimental Design

Table 1. Decomposition of temple waste (TW) using different formulations

Sets	Components	Ratio	Total weight (3kg)
1.	TW: D	2:2	1.50 kg:1.50kg
2.	TW: L	2:2	1.50 kg:1.50kg
3.	TW: L: D	2:1:1	1.50kg:0.75kg:0.75kg
4.	TW: D + *T. viride*	2:2+25gm	1.50kg:1.50kg +25gm
5.	TW: L + T. *viride*	2:2+25gm	1.50kg:1.50kg +25gm
6.	TW: D: L + T. *viride*	2:1:1+25gm	1.50kg:0.75kg:0.75kg+25gm

Table 2. Assessment of the survival rate of earthworms

Sets	Components	Ratio	Total Weight (3kg)
1.	TW Alone	3	3kg
2.	TW: D	2:1	2kg:1kg
3.	TW: D	1:2	1kg:2kg
4.	TW: D: L	1:1:1	1kg:1kg:1kg
5.	Dung (D) Alone (Control)	3	3kg

2.4 Study Design

Table 1 comprised of 6 sets having different ratios of temple waste (TW), dung (D), leaves (L) and *Trichoderma viride* (*T. viride*). Each set has a total weight of 3kg. First three sets of the experiment were not treated with *Trichoderma viride* while other three were treated with *Trichoderma viride*. In set-I temple waste and dung were taken as in 2:2 ratio (1.50kg: 1.50kg). In set-II temple waste and leaves were used as in 2:2 ratio (1.50kg: 1.50kg). In set-III temple waste, leaves and dung were taken as in 2:1:1 ratio (1.50kg: 0.75kg: 0.75kg). In set-IV temple waste and dung were used as in 2:2 ratio with 25gm of *Trichoderma viride* (1.50kg: 1.50kg +25gm). In set V temple waste and leaves were taken as in 2:2 ratio with 25gm *Trichoderma viride* (1.50kg: 1.50kg +25gm). In set VI temple waste, leaves and dung were taken as in 2:1:1 ratio with 25gm *Trichoderma viride* (1.50kg: 0.75kg: 0.75kg +25gm).

Table 2 comprised of 5 sets having different ratios of temple waste (TW), dung (D) and leaves (L). Each set has a total weight of 3kg. In set-I only temple waste (3kg) was used. In set-II temple waste and dung were used as in 2:1 ratio (2kg: 1kg). In set-III temple waste and dung were taken as in 1:2 ratio (1kg: 2kg). In set-IV temple waste, dung and leaves were used as substrate in 1:1:1 ratio (1kg: 1kg: 1kg). In set V dung (3kg) alone was taken as control.

2.5 Procedure Opted for Degradation

2.5.1 Degradation experiment

2.5.1.1 Temple waste degradation using Trichoderma viride as well as without Trichoderma viride

A series of six experiments were conducted for the purpose of temple floral waste degradation using different setups (experimental trays) having different combinations of temple floral waste, cattle dung, leaves and *Trichoderma viride* **(Table 1)**. Each tray was provided with few holes, to allow the excess of water to drain out. A jute cloth lining on bottom of each tray before the culture medium was added, so as to prevent the sticking of substrate with tray and to check the escape of worms through the holes on the other end. After a pre-decomposing period of 21 days, 100 clitellate earthworms were released in each tray. Each tray was covered with jute cloth to prevent the invasion of foreign material and outgoing of earthworms. The temperature was maintained between $20^{O}C$-$28^{O}C$ periodically by sprinkling of water throughout the experimental period to maintained moisture (50%-60%). The culture trays were monitored constantly to observe the changes. Weekly weights of experimental trays were taken to assess the variations in weights.

Percentage change in weight was calculated by using given formula:

$$Percentage\ in\ weight$$
$$= \frac{Initial\ Weight\ -\ Finial\ Weight}{Initial\ Weight} \times \mathbf{100}$$

2.5.2 Survival experiment

Experimental series were accompanied to assess the survival rate of *Eisenia fetida* using different setups and varied combinations of temple floral waste, cattle dung and leaves **(Table-II)**. After three days of the experimental setup, 100 clitellate earthworms were introduced in each set. The temperature was retained between $20^{O}C$-$28^{O}C$ and time to time sprinkling of water throughout the experimental period to maintained moisture (50%-60%). Regular examination of culture tray was done to observe the change within each substrate. Each tray was enclosed with jute cloth to avoid the incursion of external material and departing of earthworms.

2.5.2.1 Procedure for assessment of the Eisenia fetida population

Each experimental set was divided into six different quadrats of equal dimensions. The total area of the tray was divided into six equal size quadrats. Random sampling method was used to count the number of cocoons, juveniles and adult earthworms in all the squares by different individuals. This random method was adopted to check the survivability of earthworms and their rate of reproduction in the decomposing material. Data was analyzed by multiple comparison tests followed by ANOVA.

3. RESULTS

Present study was designed to manage the temple wastes by decomposition method using *Eisenia fetida* and other formulations. Following the decomposition various parameters were studied including assessment of changes in weight, decomposition rate, major visible changes during decomposition of temple waste into compost and assessment of survival rate of earthworms in different experimental setups.

3.1 Assessment of Changes in Weight

Changes in weight of the substrate is directly linked with the decomposition rate. Lesser the weight more will be the decomposition. It was observed that set-II and set-III showed less reduction in weight while set-I, set-V and set-VI showed moderate reduction in weight. Therefore, significant reduction in weight was recorded in set-IV (Table 3).

3.2 Assessment of the Rate of Decomposition in Experimental sets Having Different Formulations

Decomposition of temple waste was determined by using different formulations/ combinations. The findings of the study showed significant decomposition in all sets including Set-I (TW: D); Set-II (TW: L); Set-III (TW: L: D); Set-IV (TW: D+ *T. viride*), Set-V (TW: L+ *T. viride*) and Set-VI (TW: L: D+ *T. viride*). However, significantly higher decomposition rate was observed in Set-IV (TW: D+ *T. viride*) (Table 4).

3.3 Assessment of the Visual Changes during the Temple Waste Decomposition through Symbolic Representation

3.3.1 Major visible changes during decomposition

During the experimental study various visual changes were observed on weekly basis in all the experimental sets. The visual observations were categorized on the basis of decomposition rate. In set I, II, III minimum decomposition rate was seen, whereas sets V and VI showed moderate decomposition. However, significantly higher decomposition was visually observed in set-IV (Table 5).

3.4 Assessment of the Earthworm Population in Different Formulations

A study on vermicomposting of flower waste by utilizing epigeic earthworm species *Eisenia fetida* was carried out to find out whether worm can survive and how they decompose the Temple waste mixed with cattle dung and leaves in different ratios. Different ratios were, Set-I (TW alone); Set-II (TW: D, 2:1); Set-III (TW: D, 1:2); Set-IV (TW: D: L, 1: 1:1); Set-V (D alone).

3.4.1 Average number of adult populations

Significant variations in the results have been found in each culture combination. All the experimental culture substrates were not found to be equally suitable for survival of *E. fetida* population. The number of adult earthworms is the indicators of growth. It was observed that the adult earthworms (*Eisenia fetida*) were significantly decreased in set-I (TW alone). However, highest population of adult earthworms was observed in set-III (TW: D) (Table 6).

3.4.2 Average number of cocoon population

The number of cocoons represent the reproductive performance of the earthworms. Set-I and set-II showed minimum number of cocoons whereas set-IV showed moderate number of cocoons. However, maximum numbers of cocoons were observed in set-III (Table 7).

3.4.3 Average number of juvenile populations

The number of juveniles indicate both the reproductive and growth performance of the earthworm. Among five different sets, Set-I and set-II showed minimum number of juveniles whereas set-IV showed moderate number of juveniles. However, maximum number of juveniles was recorded in the set-III (Table 8).

Table 3. Showing changes in weight

Sets	Compositions	Weight after 1st week	Weight after 2nd week	Weight after 3rd week	Weight after 4th week	Weight after 5th week	Weight after 6th week	Weight after 7th week	Weight after 8th week
I	TW: D	3.40	3.30	3.21	3.13	3.0	2.93	2.77	2.64
II	TW: L	3.39	3.33	3.25	3.19	3.12	3.01	2.91	2.85
III	TW: L: D	3.72	3.65	3.53	3.37	3.23	3.09	2.87	2.70
IV	TW: D+*T. viride*	3.23	3.12	2.97	2.90	2.79	2.74	2.66	2.60*
V	TW: L+*T. viride*	3.30	3.25	3.12	3.05	3.0	2.89	2.76	2.63
VI	TW: L: D+ *T. viride*	3.50	3.41	3.35	3.23	3.11	2.97	2.80	2.68

*Comparison was made between different sets, Set IV v/s V (**p ≥ 0.01)*

Table 4. Showing % change in weight

Sets	Compositions	Ratio	Initial weight	Final weight (In 8th week)	Gross weight (% change)
I	TW: D	2:2	3kg	2.64	12
II	TW: L	2:2	3kg	2.85	5
III	TW: L: D	2:1:1	3kg	2.70	10
IV	TW: D + *T. viride*	2:2+ 25gm	3kg	2.60	15.38*
V	TW: L+ *T. viride*	2:2+ 25gm	3kg	2.63	12.34
VI	TW: L: D+ *T. viride*	2:1:1+ 25gm	3kg	2.68	10.67

*Comparison was made between different sets, Set VI v/s V (**p ≥ 0.01)*

Table 5. Showing rate of decomposition

Sets	Composition	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
I	TW: D	- - - - - - - -	+ - - - - - - -	+ - - - - - - -	+ + - - - - - -	+ + - - - - - -	+ + - - - - - -	+ + + - - - - -	+ + + - - - - -
II	TW: L	- - - - - - - -	- - - - - - - -	+ - - - - - - -	+ - - - - - - -	+ - - - - - - -	+ + - - - - - -	+ + - - - - - -	+ + - - - - - -
III	TW: L: D	- - - - - - - -	+ - - - - - - -	+ - - - - - - -	+ + - - - - - -	+ + - - - - - -	+ + +- - - - -	+ + + - - - - -	+ + + - - - -
IV	TW: D+*T. viride*	+ - - - - - - -	+ - - - - - - -	+ + - - - - - -	+ + + - - - - -	+ + + - - - - -	+ + + + - - - -	+ + + + - - - -	+ + + + + - - -*
V	TW: L+*T. viride*	- - - - - - - -	+ - - - - - - - -	+ - - - - - - -	+ - - - - - - -	+ + - - - - - -	+ + - - - - - -	+ + + - - - - -	+ + + + - - - -
VI	TW: L:D+*T. viride*	- - - - - - - -	+ - - - - - - -	+ - - - - - - -	+ + - - - - - -	+ + - - - - - -	+ + + - - - - -	+ + + - - - - -	+ + + + - - - -

*Comparison was made between different sets, Set IV v/s Set V; Set IV v/s VI (**p≥0.01)*

(- - - - - - - -) No decomposition, (+ - - - - - - -) Initiation of decomposition, (+ + - - - - - -) Under decomposition, (+ + + - - - - -) Slight decomposition, (+ + + + - - - -) Moderate decomposition (+ + + + + - - -) Complete decomposition

Table 6. Showing number of adults

Sets	Compositions	No. of Adults at initial stage	No. of adults after 1st week	No. of adults after 2nd week	No. of adults after 3rd week	No. of adults after 4th week
I	TW alone	50	15	12	6	-
II	TW: D (2:1)	50	18	15	15	12
III	TW: D (1:2)	50	45	54	72	102
IV	TW:D: L (1:1:1)	50	47	60	64	72
V	D Alone (Control)	50	50	96	110	138

(-) No adults

Table 7. Showing number of cocoons

Sets	Compositions	No. of cocoons in 1st week	No. of cocoons in 2nd week	No. of cocoons in 3rd week	No. of cocoons in 4th week
I	TW alone	-	6	-	-
II	TW: D (2:1)	-	12	6	-
III	TW: D (1:2)	30	51	87	132
IV	TW: D: L (1:1:1)	6	12	65	124
V	D Alone (Control)	126	102	180	372

(-) No cocoons

Table 8. Showing number of juveniles

Sets	Compositions	No. of juveniles in 1st week	No. of juveniles in 2nd week	No. of juveniles in 3rd week	No. of juveniles in 4th week
I	TW alone	-	-	4	6
II	TW: D (2:1)	-	-	6	6
III	TW: D (1:2)	-	30	45	68
IV	TW: D: L (1:1:1)	-	21	23	26
V	D Alone (Control)	-	36	56	84

(-) No juveniles

4. DISCUSSION

During 1st week, the weight of all sets was recorded as, set-I (3.40), set-II (3.39), set-III (3.72), set-IV (3.23), set-V (3.30) and set-VI (3.50).

All the experimental sets showed increase in weight due to the regular sprinkling of water. However, minimum increase in weight was observed in set-IV, whereas maximum weight was observed in set-III. In 2nd week, the weight was recorded as set-I (3.30), set-II (3.33), set-III (3.65), set-IV (3.12), set-V (3.25) and set-VI (3.41). In week 2nd reduction in weight was observed in each set as compared to week one. Maximum reduction in weight was recorded in set IV while minimum reduction of weight in set III. In 3rd week the weight of each set was as follows: set-I (3.21), set-II (3.25), set-III (3.53), set-IV (2.97), set-V (3.12) and set-VI (3.35). In 4th week the change in weight was recorded as, set-I (3.13), set-II (3.19), set-III (3.37), set-IV (2.90), set-V (3.05) and set-VI (3.23). In week 5th and 6th the weight of each set was recorded as set-I (3.0); (2.93), set-II (3.12); (3.01), set-III (3.23); (3.09), set-IV (2.79); (2.74), set-V (3.0);

(2.89) and set-VI (3.11); (2.97) respectively. In 7th and 8th week the weight was observed as set-I (2.77); (2.64), set-II (2.91); (2.85), set-III (2.87); (2.70), set-IV (2.66); (2.60), set-V (2.67); (2.63) and set-VI (2.80); (2.68) respectively. This variation in weight could be due to the use of different formulations, in set-IV use of *Trichoderma viride* enhanced the decomposition process and resulted in minimum increase in weight, whereas in set-III, *Trichoderma viride* was not introduced and hence showed the maximum increase in weight. These findings are in agreement with earlier studies that use of fungal formulation (*Trichoderma viride*) increases microbial inoculation (MIT) which accelerate degradation of the temple waste [16, 17]. *Trichoderma* fungus is well known for its degrading activities [18-21]. From all these observations it was found that with every increasing week there was change in the weight of each experimental set. However, significant change in weight was found in set-IV. Moreover, these changes in weight were further analyzed by calculating the percent change in weight, which further confirms our results that weight varies from set to set due to use of separate formulations. The percent change in weight were calculated in different sets, in sets I, II, III, IV V and VI the percent change in weight was 12%, 5%, 10%, 15.38%, 12.34% and 10.67% respectively. However, it was found that set IV (TW: D+ *T. viride*) showed maximum percentage (15.38%) change in the weight, which indicated that decomposition rate is higher in set IV, because this set does not contain leaves. Leaves contains minimum nutrients, earthworms and other decomposing organisms never act on the nutrient-less substrate and hence slow decomposition was observed. Moreover, use of fungal formulation (*Trichoderma viride*) increases microbial inoculation (MIT) which accelerate degradation of the temple waste [16, 17] and increase the content of nutrients including nitrogen [22, 16]. Addition of *Trichoderma* promotes the composting process by increasing the synthesis of degradation enzymes such as xylanase and cellulose [23]. Amira et al. [24] also reported that *Trichoderma virens* reduces the time duration required for decomposition of lignocellulosic wastes due to the high production of degrading enzymes. *Trichoderma* is able to convert wastes (e.g., temple waste) into humidified substances by producing cellulolytic and ligninolytic enzymes. Fukasawa et al. [25] used fungal cultures for decomposition of collected dry flowers. However, least percent change was recorded in the set-II (5%) followed by set-III (10%) and set VI (10.67%). All these sets were consisted of leaves, and leaves contain minimum nutritional constituents and thus, earthworms took time to degrade them and it delayed the decomposition process. It is reported that *Eisenia fetida* is greatly affected by the quality and type of the food material [26]. However, in sets I and V moderate percentage change (i.e. 12% and 12.34% respectively) was recorded. In these two sets dung was used along with leaves and it was observed that dung increased the process of composting. The results of the present study correlate with the findings of other scientists [27, 28] that the feeding rate of earthworms is directly related to the food availability and resources allocated.

However, significant increase in number of adults, cocoons and juveniles was recorded in set-III because of the use of dung with temple waste. Worms in cattle manure produced a higher number of cocoons and young worms. The number of cocoons and juveniles was higher in control (set-V) than in the set-III. Similar results were reported by Gupta et al. [29], where the maximum worm growth was recorded in cow dung alone. According to a previous study conducted by Loh et al. [30] that cattle manure provided a better environment for the earthworm to grow and it produced a higher quantity of vermin cast. The temple waste alone and the sets containing high amount of temple waste were not suitable for the survival of adult worms and the number of adult worms was reduced as compared to the initial values. There may be several factors responsible for such negative effects on the biology of earthworms like non-hostile environment, lack of aeration, lower C/N ratio, very low or higher pH values, high temperature due to exothermic reactions, release of repellents and toxic components and by anaerobic microorganisms etc. The conditions in temple waste-enriched media were unfavorable for both of the survival of the adult worms and their reproductive performance. The fecundity rate was low and number of cocoons and juveniles were significantly lower in the temple waste enriched media. If the raw material is edible, biomass is gained by the worms, although overall biomass depends on the feed quality and environmental conditions [31]. Similar results of Vinceslas-Akpa and Loquet [32] showed that lowest number of worms in temple waste containing media may be because of the presence of lignin rich materials which are less preferable to earthworms and their survival. These findings are supported by Chaudhuri et al. [33] that earthworms showed lower rate of biomass increase and reproduction in the mixture of kitchen waste than in cow dung. With decreasing content of the temple waste and increasing ratio of dung, the living conditions became better and improvement in sets containing dung was observed. The results of present study are in agreement with observations of several earlier researchers on vermicomposting of kitchen and vegetable waste used different methods and different species of earthworm [34-39].

5. CONCLUSION

Present study was carried out to manage the temple wastes by decomposition method using different formulations and to check the survival rate of *Eisenia fetida*. After the completion of experimental period, it was observed that the significant higher decomposition rate was observed in Set IV- (TW: D+ *T. viride*) while least decomposition rate was observed Set II- (TW: L). Hence, it is concluded that *Trichoderma* plays significant role in decomposition, as it promotes the enzymatic activity which ultimately increase the rate of decomposition. It is also concluded that the temple waste alone could not be suitable for survival of earthworms because of the increased amount of pigmented constituents in the temple waste. Current study also demonstrates that temple waste does not improve the number of earthworms, and thus increased the mortality of earthworms. However, it was found that temple waste alone is not a suitable substrate for vermicomposting and it should be blended with other suitable waste materials such as dung, leaves in suitable proportions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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