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Research Article

EFFECT OF DIFFERENT COMBINATIONS OF BUFFALO DUNG WITH VEGETABLE WASTES AND BANANA PEELS ON THE REPRODUCTIVE POTENTIAL OF EARTHWORM *LAMPITO MAURITII* (KINBERG)

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ABSTRACT
The indigenous earthworm *Lampito mauritii* (Kinberg) have more potential for biological waste management and soil health enhancement. In this study the effects of various combinations of vegetable waste and banana peels with buffalo dung on the earthworm *Lampito mauritii* ability for reproductive performance was observed. If they are not correctly managed, animal manure, vegetable wastes, and banana peels can cause a various health and environmental issues. Vermicomposting is an appropriate method for producing and managing vermicompost. The earthworm *Lampito mauritii* has more potential for maintaining soil fertility and recycling biological waste.
The feed material and ecological factors are major source for growth and reproduction of earthworms. There was significant effect of combination of buffalo dung (BD) with Vegetable wastes (VW) and Banana peels (BP) on the reproduction potential of earthworm *Lampito mauritii.* The maximum decrease in initiation of clitellum development (14.50 ±0.22 days) cocoon production (26.17±0.42 days) period of cocoon formation (14.83±0.40), incubation period (25.83±0.60) and significant increase in cocoon/worm production (25.33±0.42) hatchlings/cocoon (2.17±0.31) as well as reproduction rate (hatchling/worm 54.96) was observed in feed material combination of buffalo dung (BD) with vegetable waste (VW) in ratio of (3:1) among all the combinations of wastes with respect to control group. Whereas, significant maximum biomass production was observed in combination of BD + VW in ratio of (4:1). The result indicates that the combination of BD + VW is a best feed material for better growth and development of earthworm *Lampito mauritii* which is followed by BD+BP.

Keywords: *Banana peels, Buffalo dung, Lampito mauritii, Reproduction, Vegetable waste, Vermicomposting.*

INTRODUCTION
Indiscriminate use of chemical fertilizer, insecticides, herbicides and agro-chemicals have made our soil sick and problematic (Gupta 2005; Hossain *et al,* 2022; Saha *et al*., 2024). India produces significant amounts of biological wastes every year (Mohite *et al*., 2024). If these biological wastes are not effectively managed, they may have negative effects on both the environment and human health (Singh and Singh, 2023; Yadav and Singh 2024). Every year, huge quantities of fruit and vegetable waste are produced, which causes major financial and nutritional losses while also contributing to environmental issues. Due to the high biodegradability of discarded fruit and vegetable waste causes numerous health and environmental problems. (Bouallaguiet *et al*., 2004). Vegetable waste is an excellent source for vermicomposting and the producing high quality biofertilizers (Jadia and Fulekar, 2008). Banana peels are highly rich with vitamins, carbohydrate, raw protein, crude fat, total dietary fiber, polyunsaturated fatty acids, and the micronutrient calcium, phosphorus, potassium and magnesium (Mohapatra *et al*., 2010). Traditionally, breaking down of banana peels to boost soil nutrients has been used as a fertilizer. 36 million tonnes of banana peels are

produced annually (Vu *et al*., 2018). Banana peels also contain significant amounts of K++, Mg++, Ca++, and other minerals (Aboul-Enein et al., 2016). Vermicompost made from a combination of cow dung and banana peels greatly increases agricultural yield and plant development (Mohanapriya *et al*., 2021). The vermicomposting is a biotechnological technique that uses inoculated earthworms to transform organic waste into, nutrient-rich vermicompost. The Vermicomposting is a less costly, safe, and environmentally beneficial tools (Singh and Singh, 2024; Dey Chowdhury *et al*., 2026). The vermicompost has more nutrients, growth hormones, and microorganisms that are beneficial for plant growth and productivity (Gupta, 2005; Siddiqui *et al*., 2022; Yadav and Singh, 2026). Fatima *et al*., (2023) reported that the kitchen waste are managed by vermicomposting technology. Kitchen waste and other organic materials can be vermicomposted to improve its nutrient content and quality (Yadav and Garg, 2019). Sadia *et al*., (2020) reported that the feeding *Perionyx excavatus* with a mixture of cow manure, vegetable scraps, and banana trunk significantly improves their growth and reproduction. When provided with vegetable and papaya waste, the earthworms also gain length and body weight (Liberty *et al*., 2022). Gergs *et al*., (2022) observed that the organic waste from restaurants, canteens, homes, municipalities, farms, and other sources is best treated with anecic species. *Lampito mauritii* has a high rate of waste breakdown and is capable of vermicomposting a wide range of organic wastes (Suthar and Singh, 2008). The objective of the present experiment was to improve *Lampito mauritii* growth and development in a particular combination that is crucial for boosting the processing of organic waste into efficient vermicompost material.

MATERIALS AND METHODS

Collection and rearing of the earthworm Lampito mauritii:

The Vermibiotechnology Laboratory, Department of Zoology, Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur, provided the cultured earthworm species *Lampito mauritii* used in this experiment. In laboratory conditions, vermibed was prepared by using vegetable wastes with buffalo dung on a cemented surface for the experiment.

Collection of vegetable wastes and banana peels and buffalo dung:

Vegetable wastes (VW) and banana peels (BP) were obtained from the local area of Gorakhpur district and buffalo dung was collected from different farmhouses that were located around the area. Buffalo dung (BD) was spread out in a layer and exposed to sunlight for twenty days in order to eliminate a number of harmful organisms and noxious gasses. These biological wastes had been prepared and then utilized as vermicomposting feed material in the experiment (Garg et al., 2005).

Experimental setup:

The experiment was conducted on a cemented earth surface. Two kilograms of buffalo dung in both binary and Tertiary combinations with different ratios of vegetable waste and banana peels i.e. BD+VW (1:1, 2:1, 3:1 ,4:1 and 1:2, 1:3,1:4), and whereas, BD+BP (1:1, 2:1, 3:1 ,4:1 and 1:2, 1:3,1:4), and BD+VW+BP (1:1:1 ,1:2:1, 1:3:1, 1:4:1; 1:1:2, 1:1:3, 1:1:4; 2:1:1, 3:1:1, 4:1:1), as well as BD alone were prepared in beds of (30cm x 30cm x 10cm) at room temperature in the dark. The growth and development study of earthworm *Lampito mauritii* was carried by Garg and Kaushik, (2005). The vermicomposting beds were manually turned every 24 hours to remove inorganic substances for ten days. After this, 20 newly hatched *Lampito mauritii* have been introduced to each bed. Each experiment was repeated six times (Siddhqui and Singh, 2024).

Reproduction and growth rate of the earthworm Lampito mauritii:

Every week, cocoons were collected from the experimental beds using a 0.5 mm mesh sieve, gently washed with distilled water to remove adhering debris, and counted individually. The culture beds were inspected daily for newly formed cocoons, which were immediately isolated and transferred individually to Petri dishes lined with moist filter paper. The Petri dishes were maintained at 30 ± 2°C and 70 ± 5% relative humidity until hatching. The incubation period was determined by recording the time required for cocoon hatching, and the number of hatchlings emerging from each cocoon was recorded. At weekly intervals, the spent culture substrate was replaced with an equal quantity of fresh substrate to ensure a continuous food supply throughout the experimental period, thereby preventing food limitation. Earthworm biomass was recorded at 15-day intervals up to 90 days, and the growth rate (GR) was calculated using the following formula: $GR = (Wf - Wi) / \Delta t$, where Wi is the initial body weight (mg), Wf is the final body weight (mg), and Δt is the time interval (days). Biomass gain was recorded after 15 days interval up to 90 days in each bed (Singh and Singh, 2024).

Statistical Analysis:

Each experiment was conducted in six replicates to ensure the consistency of the results, and the data are presented as mean ± standard error (SE). Analysis of variance (ANOVA) was used to determine significant differences among the treatment combinations, while Student's *t*-test ($p < 0.05$) was performed to compare each treatment with the control and to identify the bedding combinations that significantly affected the growth and reproduction of *Lampito mauritii* (Sokal and Rohlf, 1973).

RESULTS

During vermicomposting, feed materials of binary and tertiary combinations of buffalo dung with vegetable waste and banana peels showed notable clitellum development, cocoon production, and cocoon formation from worms. The significant effect was observed in all the combinations of buffalo dung (BD) with vegetable wastes (VW) and banana peels (BP) on initiation of clitellum (days), initiation of cocoon production and hatchling per cocoon as well as reproductive rate (hatchling per worm) (Table 1-3 and Figure 1-6). In all the combinations of buffalo dung (BD) with vegetable wastes (VW) and banana peels (BP), the development of clitellum was significantly earlier (14.50 ±0.22) in binary combination of buffalo dung (BD) with vegetable wastes (VW) in ratio (3:1) followed by (15.17 ±0.48) in ratio BD+BP (1:1) and BD+VW+BP (16.83 ±0.6) in ratio (1:1:1) (Table 1-3 and figure 1-3).

Table 1-3 and figure 1-3 showed the significant effect of different combinations of buffalo dung with vegetable wastes (VW) and banana peels (BP) on initiation of cocoon production (days). The significant earlier initiation of cocoon production was observed in combination of BD+VW (3:1 ratio) (26.17±0.40 days) which is followed by BD+BP (1:1 ratio) (27.50±0.62)) and BD+VW+BP (1:1:1 ratio) (28.33±0.42) with respect to all the combination BD+VW+BP and buffalo dung (BD) alone.

Among all the combination of feed material of combination BD+VW+BP, the combination of BD+BP in the ratio (1:1) have earlier significant (17.50±0.56 days) period of cocoon formation which is followed by BD+VW (3:1) and BD+VW+BP in the ratio 1:1:1 whereas earlier significant incubation period (days) (25.33±0.67) was observed in combination of BD+BP in 1:1 ratio which is followed by BD+VW (25.83±0.60) in the ratio (3:1) and (27.33±0.63) in BD+VW+BP (1:1:1) ratio.

The maximum (25.33±0.42) cocoon per worm production was observed in combination of BD+VW in ratio (3:1) which is followed by combination of BD+BP (1:1) (23.17±0.23) and (22.17±0.60) in BD+VW+BP in ratio (1:1:1) (Table 1-3 and Figure 4-6). Whereas the maximum hatching per cocoon (02.17±0.310) and maximum (54.96) reproduction rate (hatching per worm) were observed in combination of BD+VW (3:1 ratio) (Table 1-3 and Figure 4-6).

There was significant growth rate and biomass of *Lampito mauritii* was observed in all the combination of BD+VW+BP. Among all the combination of BD+VW+BP, the maximum growth rate (9.15±0.22 mg/worm/day) was observed in the combination of BD+VW in ratio (4:1) which is followed by combination of BD+BP (1:1) (9.12±0.27) and (8.32±0.11) for BD+VW+BP in ratio (4:1:1) (Table 4-6 and Figure 7-9).

DISCUSSION

The significant effect was observed in all the combination of buffalo dung (BD) with vegetable waste (VW) and banana peels (BP) on initiation of clitellum (days), initiation of cocoon production (days), period of cocoon formation, incubation period, cocoon per worm production and hatching per cocoon as well as reproduction rate (hatching per worm).

Table 1. Effect of different combinations of buffalo dung with vegetable waste on the production of cocoon and hatchling of *Lampito mauritii.*

Combinations	Initiation of clitellum (in days)	Initiation of cocoon production (in days)	Period of cocoon formation	Incubation period (days)	Cocoon/worm	Hatchling/Cocoon	Reproduction rate (hatchling/worm)
BD	23.83 ±0.31b	35.33± 0.42a	20.33 ± 0.42b	32.17 ± 0.31a	15.83 ± 0.40b	1.67± 0.21a	26.44
BD+VW(1:1)	16.83 ±0.31c	26.33± 0.40c	18.50± 0.43b	30.33 ± 0.42a	16.33 ± 0.42b	2.00± 0.31a	32.66
BD+VW(1:2)	19.00 ±0.37c	27.50± 0.43c	19.33± 0.42b	33.00 ± 0.45a	15.17 ± 0.40c	1.67 ± 0.42a	25.33
BD+VW(2:1)	17.83 ±0.31c	30.33± 0.49c	18.00 ± 0.52b	28.50± 0.43a	20.17 ± 0.40b	1.83 ± 0.17a	36.91
BD+VW(1:3)	22.50 ±0.50b	29.33 ± 0.67c	22.33± 0.42a	34.17± 0.31a	14.83 ± 0.31c	1.50± 0.34a	22.25
BD+VW(3:1)	14.50 ± 0.22d	26.17± 0.42c	14.83 ± 0.40c	25.83 ± 0.60a	25.33± 0.42a	2.17 ± 0.31a	54.96
BD+VW(1:4)	25.67±0.33a	32.17±0.54b	23.17± 0.48a	35.83± 0.40a	13.33± 0.42c	1.33 ± 0.33a	17.73
BD+VW(4:1)	16.33±0.33c	28.33±0.49c	16.83 ± 0.31b	27.83±0.40a	21.17± 0.40b	2.00± 0.45a	42.34

*Each value is the mean ± SE of six replicates. BD = Buffalo Dung, VW= Vegetable waste *Mean differences in column followed by common letter are not significant at $P < 0.05$ (DMRT) in 30.0x30.0x10.0 cm^3 area of vermicompost bed.*

Table 2. Effect of different combinations of buffalo dung with banana peels on the production of cocoon and hatchling of *Lampito mauritii.*

Combinations	Initiation of clitellum (in days)	Initiation of cocoon production (in days)	Period of cocoon formation	Incubation period (days)	Cocoon/worm	Hatchling/Cocoon	Reproduction rate (hatchling/worm)
BD	23.83 ± 0.31a	35.33± 0.42a	20.33 ± 0.42a	32.17 ± 0.31a	15.83 ± 0.40c	1.67± 0.21a	26.44
BD+BP(1:1)	15.17± 0.48c	27.50 ± 0.62b	17.50 ± 0.56a	25.33 ± 0.67a	23.17 ± 0.23a	2.00± 0.26a	46.34
BD+BP(1:2)	18.17± 0.95c	28.17 ± 0.60b	20.00 ± 1.06a	27.17 ± 0.60a	16.00 ± 0.60c	1.67± 0.42a	26.72
BD+BP(2:1)	16.33 ± 0.42c	31.17± 0.70b	19.50 ± 1.31a	26.33 ± 0.56a	19.67± 0.49b	1.67± 0.21a	32.85
BD+BP(1:3)	21.67 ± 0.80b	28.50 ± 0.76b	23.50± 1.18a	29.17± 0.48a	14.33± 0.84c	1.50± 0.34a	21.50
BD+BP(3:1)	17.17± 0.70c	30.17 ± 1.14b	22.17 ± 1.42a	27.83 ± 0.60a	20.67± 0.71b	1.17± 0.31a	24.18
BD+BP(1:4)	25.17± 0.87a	29.33± 0.88b	26.67±1.15a	36.33± 0.99a	15.17 ± 0.54c	1.50± 0.43a	22.76
BD+BP(4:1)	16.50 ± 0.62c	32.17 ±1.47b	24.17±1.01a	28.17 ± 0.83a	21.17 ± 0.60b	1.33± 0.33a	28.16

Each value is the mean ± SE of six replicates. BD = Buffalo dung, BP= Banana peels
**Mean differences in column followed by common letter are not significant at $P < 0.05$ (DMRT) in 30.0x30.0x10.0 cm^3 area of vermicompost bed.*

Table 3. Effect of different combinations of buffalo dung with vegetable waste and banana peels on the production of cocoon and hatchling of *Lampito mauritii.*

Combinations	Initiation of clitellum (in days)	Initiation of cocoon production (in days)	Period of cocoon formation	Incubation period (days)	Cocoon/worm	Hatchling/Cocoon	Reproduction rate (hatchling/worm)
BD	23.83 ± 0.31b	35.33± 0.42a	20.33 ± 0.42c	32.17 ± 0.31a	15.83 ± 0.40	1.67± 0.21a	26.44
BD+VW+BP (1:1:1)	16.83 ± 0.65e	28.33 ± 0.42a	18.67± 0.41d	27.33 ± 0.63a	22.17±0.60	2.00 ± 0.58a	44.34
BD+VW+BP (1:2:1)	20.00± 0.45d	29.67± 0.43a	21.33± 0.42c	29.50 ± 0.56a	17.17 ± 0.65	1.50± 0.22a	25.76
BD+VW+BP (1:1:2)	22.33 ± 0.12c	30.53± 0.62a	22.17 ± 0.31c	29.00 ± 0.68a	18.83 ± 0.48	1.33 ± 0.33a	25.04
BD+VW+BP (2:1:1)	19.83 ± 0.48c	32.17 ± 0.70a	20.17 ± 0.40c	28.83 ± 0.40a	20.17± 0.48	1.17 ± 0.40a	23.60
BD+VW+BP (1:3:1)	23.17 ± 0.24b	35.67 ± 0.61a	24.83± 0.31a	30.17± 0.31a	16.50± 0.76	1.50± 0.43a	24.75
BD+VW+BP (1:1:3)	24.17± 0.31b	36.17± 0.54a	25.17± 0.31a	31.67± 0.42a	17.33±0.33	1.17 ± 0.31a	20.28
BD+VW+BP (3:1:1)	20.67± 0.33d	33.67± 0.84a	23.50 ± 0.43b	29.17± 0.31a	19.33±0.42	1.17 ± 0.60a	22.62
BD+VW+BP (1:4:1)	25.17± 0.24a	36.83± 0.48a	27.17± 0.31a	31.83 ± 0.40a	17.83±0.60	1.33 ± 0.49a	23.71
BD+VW+BP (1:1:4)	26.33± 0.42a	37.00± 0.52a	26.67± 0.42a	32.67± 0.49a	16.83±0.31	1.17 ± 0.48a	19.69
BD+VW+BP (4:1:1)	21.17± 0.31d	34.17± 0.48a	26.17± 0.31a	30.50 ± 0.43a	18.17±0.31	1.67± 0.42a	30.34

Each value is the mean ± SE of six replicates. BD = Buffalo dung, VW=Vegetable waste, BP= Banana peels
**Mean differences in column followed by common letter are not significant at $P < 0.05$ (DMRT) in 30.0x30.0x10.0 cm^3 area of vermicompost bed.*

Table 4. Effect of different combinations of buffalo dung with vegetable waste on the biomass production of *Lampito mauritii*.

Combinations	Initial weight (mg)	Max. weight (mg)	Net weight (mg)	Growth rate (mg/worm/day)
BD	220.17 ± 4.50	864.33 ± 7.43e	644.17 ± 5.82b	7.16±0.19
BD+VW(1:1)	237.00 ± 6.36	937.83± 5.95c	700.83± 10.5b	7.78±0.26
BD+VW(1:2)	229.17 ± 5.46	898.67± 7.66d	669.50± 12.5b	7.76±0.23
BD+VW(2:1)	241.50 ± 6.16	897.67 ± 8.92d	656.17± 9.48b	7.29±0.18
BD+VW(1:3)	227.17 ± 4.66	853.17± 6.05e	628.00± 11.6b	6.98±0.20
BD+VW(3:1)	248.17 ± 6.74	1027.33± 4.23b	779.17± 16.3a	8.66±0.21
BD+VW(1:4)	225.33± 5.71	823.33± 5.25f	598.00± 6.94c	6.65±0.25
BD+VW(4:1)	253.00± 5.53	1076.67± 8.75a	823.67± 19.8a	9.15±0.22

Each value is the mean ± SE of six replicates. BD = Buffalo Dung, VW = Vegetable waste
**Mean differences in column followed by common letter are not significant at P < 0.05 (DMRT) in 30.0x30.0x10.0 cm^3 area of vermicompost bed.*

Table 5. Effect of different combinations of buffalo dung with banana peels on the biomass production of *Lampito mauritii*.

Combinations	Initial weight (mg)	Max. weight (mg)	Net weight (mg)	Growth rate (mg/worm/day)
BD	220.17 ± 4.50	864.33 ± 7.43d	644.17 ± 5.82b	7.16±0.19
BD+BP(1:1)	242.17±5.19	1063.17±6.39a	821.00±9.09a	9.12±0.27
BD+BP(1:2)	235.50±5.92	926.33±5.71b	691.33±13.7b	7.64±0.25
BD+BP(2:1)	239.17±6.20	898.00±7.19c	659.00± 12.3b	7.32±0.18
BD+BP(1:3)	229.33±4.62	816.17±7.13e	587.00±8.85c	6.50±0.19
BD+BP(3:1)	237.17±5.73	872.33±6.10d	635.17±15.2b	7.05±0.22
BD+BP(1:4)	223.33±5.69	807.33±3.89e	584.00±4.64c	6.48±0.17
BD+BP(4:1)	240.00±5.95	902.17±5.46c	662.17±9.23b	7.35±0.28

Each value is the mean ± SE of six replicates. BD = Buffalo Dung, BP= Banana peels
**Mean differences in column followed by common letter are not significant at P < 0.05 (DMRT) in 30.0x30.0x10.0 cm^3 area of vermicompost bed.*

Table 6. Effect of different combinations of buffalo dung with vegetable waste and banana peels on the biomass production of *Lampito mauritii*.

Combinations	Initial weight (mg)	Max. weight (mg)	Net weight (mg)	Growth rate (mg/worm/day)
BD	220.17 ± 4.50	864.33 ± 7.43d	644.17 ± 5.82c	7.16±0.19
BD+VW+BP(1:1:1)	232.33± 5.81	904.67±9.58c	671.83±5.80b	7.46±0.12
BD+VW+BP(1:2:1)	226.17± 5.33	864.00±6.04d	638.00±4.03c	7.08±0.13
BD+VW+BP(1:1:2)	221.17±7.94	853.83±8.81d	632.00±7.52c	7.02±0.18
BD+VW+BP(2:1:1)	237.17±7.70	918.83±6.36c	688.83±7.56b	7.56±0.14
BD+VW+BP(1:3:1)	218.00±8.10	849.33±10.18d	631.00±6.81c	7.01±0.16
BD+VW+BP(1:1:3)	214.17±4.84	838.17±7.19d	624.00±6.91c	6.93±0.22
BD+VW+BP(3:1:1)	257.50±10.08	964.17±10.62b	707.00±8.93b	7.85±0.21
BD+VW+BP(1:4:1)	215.67± 4.12	832.50±7.42d	617.17±8.75c	6.85±0.23
BD+VW+BP(1:1:4)	227.17± 5.92	827.50±6.13d	609.00±13.64c	6.77±0.15
BD+VW+BP(4:1:1)	272.33± 6.82	1021.83±4.41a	749.00±5.70a	8.32±0.19

Each value is the mean ± SE of six replicates. BD = Buffalo Dung, BP= Banana peels
**Mean differences in column followed by common letter are not significant at $P < 0.05$ (DMRT) in $30.0x30.0x10.0\ cm^3$ area of vermicompost bed.*

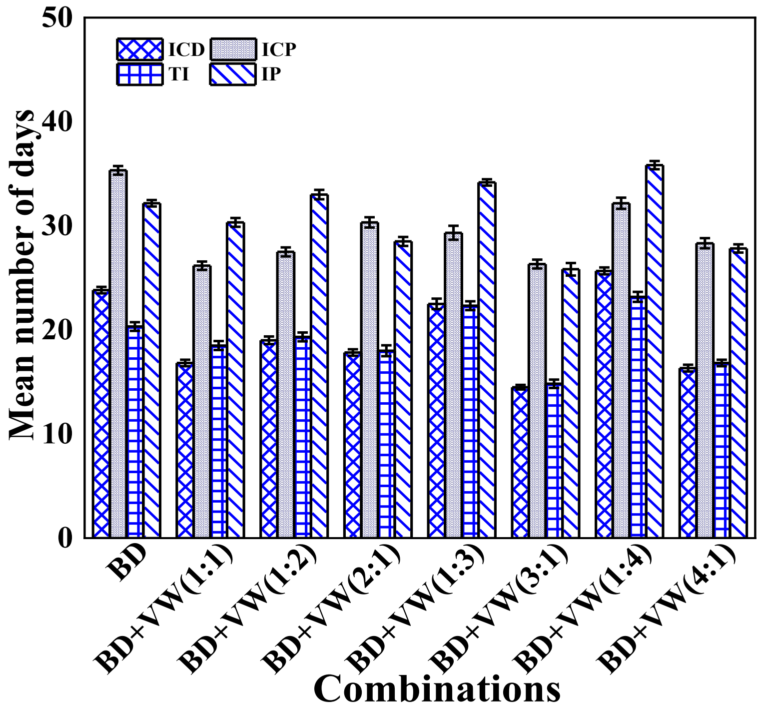

Figure 1: Effect of different combinations of buffalo dung with vegetable waste on the initiation of clitellum development and cocoon production of *Lampito mauritii.* ICD= Initiation of clitellum development (days), ICP= Initiation of cocoon production (days), TI= Time taken for cocoon production after initiation of clitellum development, IP= Incubation period, BD= buffalo dung, VW= Vegetable waste.

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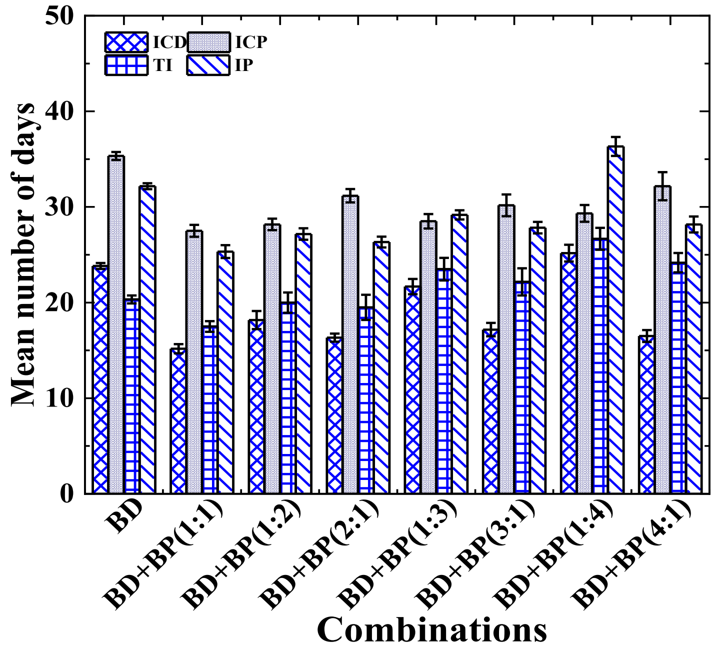

Figure 2: Effect of different combinations of buffalo dung with Banana peel on the initiation of clitellum development and cocoon production of *Lampito mauritii.* ICD= Initiation of clitellum development (days), ICP= Initiation of cocoon production (days), TI= Time taken for cocoon production after initiation of clitellum development, IP= Incubation period, BD= buffalo dung, BP= Banana peel.

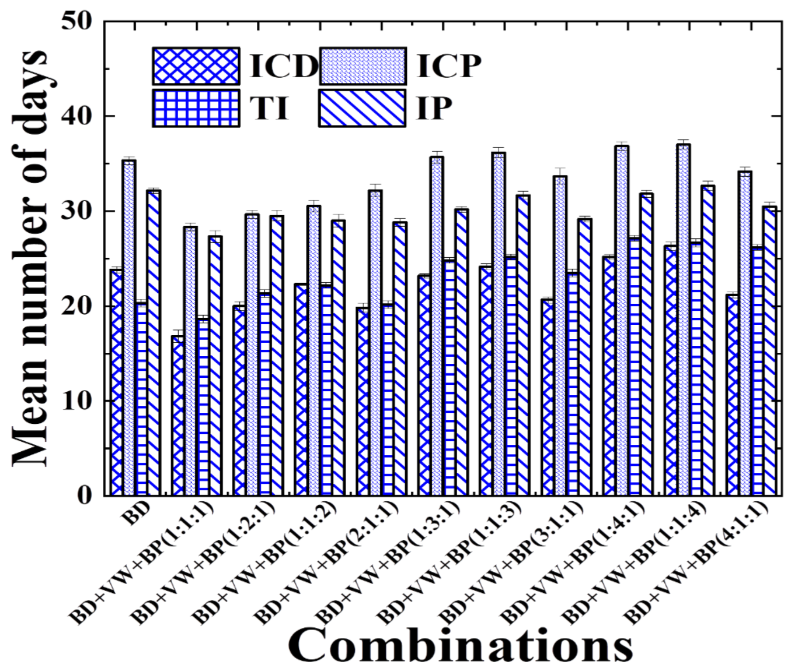

Figure 3: Effect of different combinations of buffalo dung with Vegetable waste and Banana peel on the initiation of clitellum development and cocoon production of *Lampito mauritii.* ICD= Initiation of clitellum development (days), ICP= Initiation of cocoon production (days), TI= Time taken for cocoon production after initiation of clitellum development, IP= Incubation period, BD= buffalo dung, VW= Vegetable waste, BP= Banana peel.

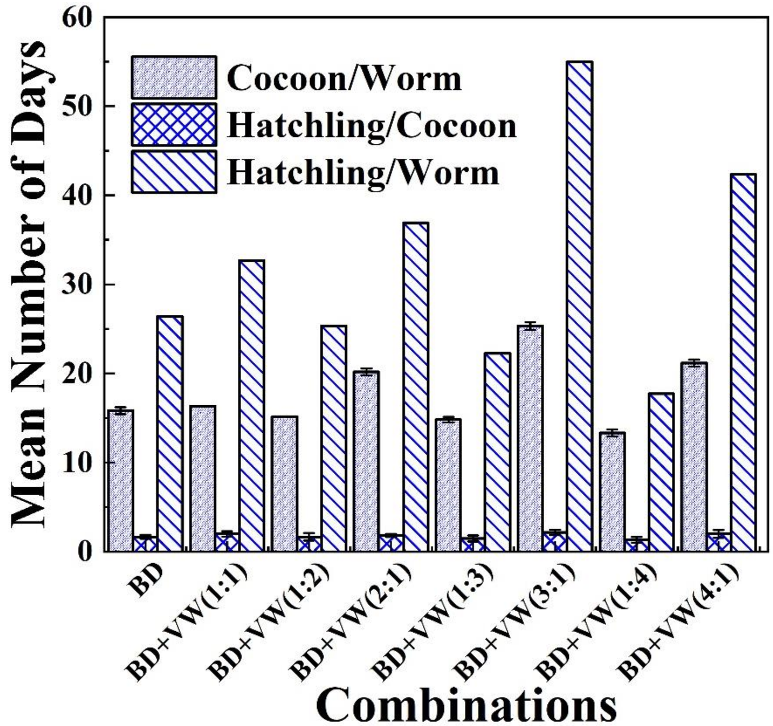

Figure 4: Effect of different combinations of buffalo dung with Vegetable waste on the production of cocoon and hatchling of *Lampito mauritii.* BD= Buffalo dung, VW= Vegetable waste.

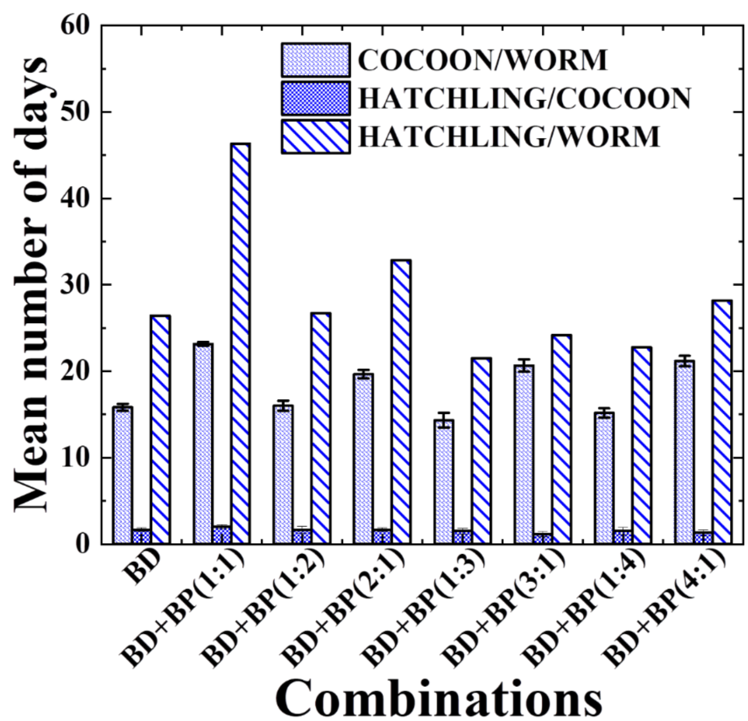

Figure 5: Effect of different combinations of buffalo dung with Banana peels on the production of cocoon and hatchling of *Lampito mauritii*. BD= Buffalo dung, BP= Banana peel.

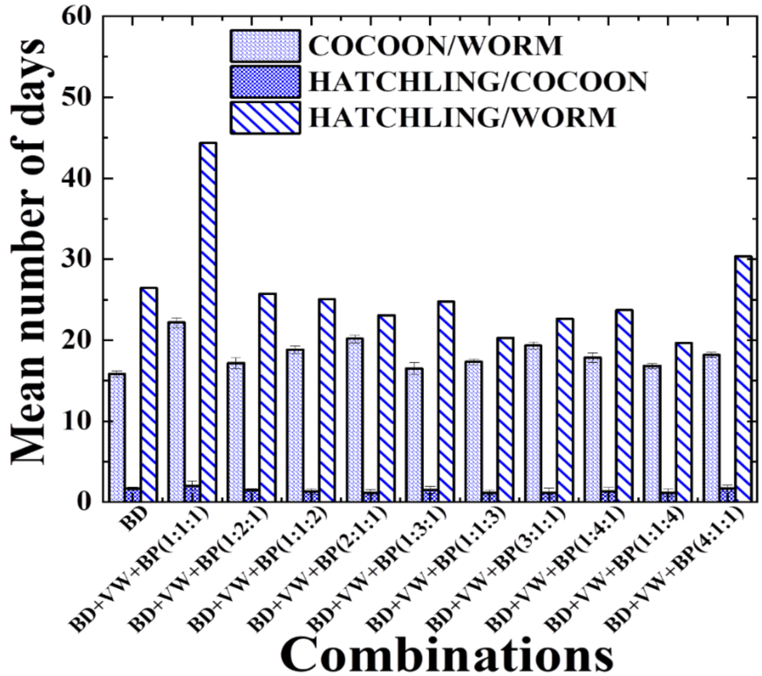

Figure 6: Effect of different combinations of buffalo dung with Vegetable waste and Banana peel on the production of cocoon and hatchling of *Lampito mauritii.* BD= Buffalo dung, VW= Vegetable waste, BP= Banana peel.

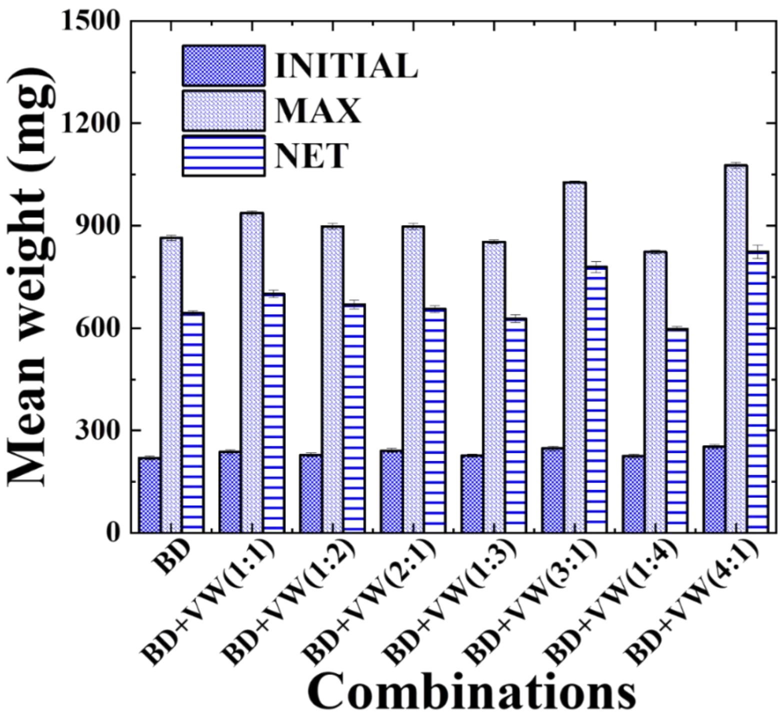

Figure 7: Effect of different combinations of buffalo dung with Vegetable waste on the growth of *Lampito mauritii*. BD= Buffalo dung, VW= Vegetable waste.

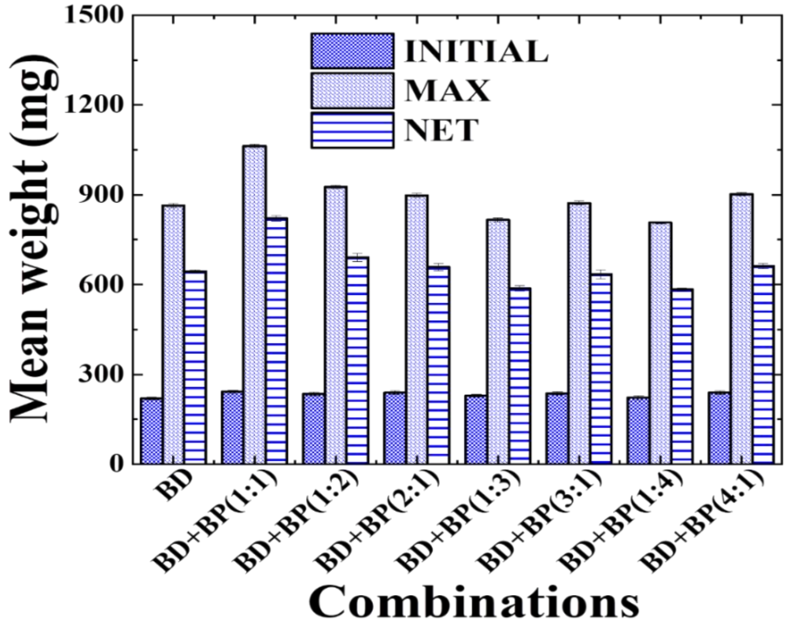

Figure 8: Effect of different combinations of buffalo dung with Banana peels on the growth of *Lampito mauritii*. BD= Buffalo dung, BP= Banana peel.

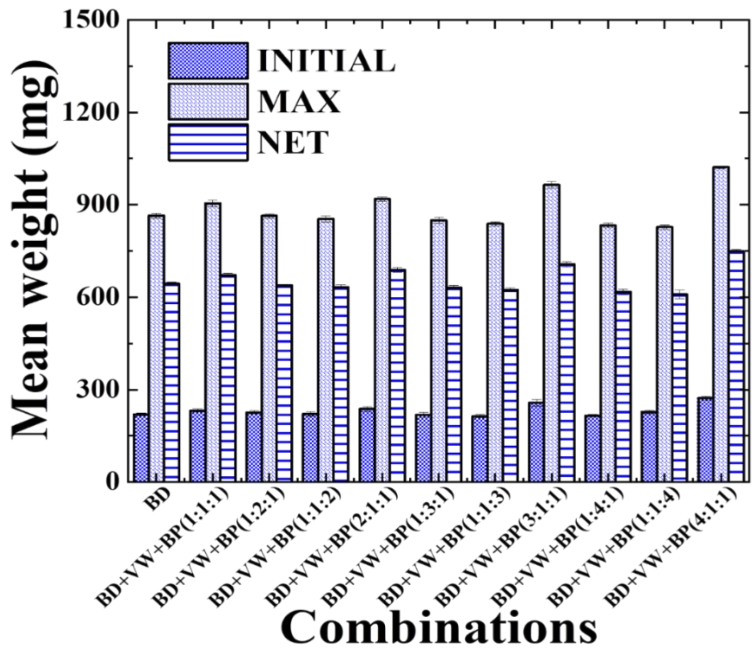

Figure 9: Effect of different combinations of buffalo dung with Vegetable waste and Banana peel on the growth of *Lampito mauritii*. BD= Buffalo dung, VW= Vegetable waste, BP= Banana peel.

It may be due to presence of organic carbon, high pH and electrical conductivity (EC) in the initial feed material along with a decrease in the Carbon to Nitrogen (C/N) ratio during vermicomposting (Chauhan and Singh 2012a; Singh and Singh, 2024). Kitchen waste are rich in carbohydrates and minerals, which may provide the necessary nutrients to stimulate reproduction maturity in the earthworms (Suthar 2007;

Suthar and Singh 2008). The amount of Nitrogen in the substrate is an important factor which support the reproduction development (Suthar 2007a).

The different combinations of buffalo dung, vegetable waste and banana peels, which showed high initial pH, EC, TAP, TCa and C/N ratio, provided suitable conditions for early cocoon production. The physico-chemical nature of feeding material is primarily important for rearing of earthworms in organic wastes as well as the difference in cocoon production may be due to the variation in quantity of substance in each feed mixture (Suthar, 2007b).

The significant short duration for the first cocoon production was observed in low pH and significant increase of TAP during vermicomposting. Suthar (2009) reported that substrate with diverse organic waste including buffalo waste, kitchen waste and banana peels provide favourable condition of cocoon production. High Nitrogen and phosphorus support the reproductive process and energy requirement for cocoon production (Suthar 2007a).

The incubation period for anecic species ranges from 28 to 42 days depending on environmental condition (Butt, 1993). Edwards et al., (1998) reported the life cycle of earth worm with respect to population density and observed that earthworm thrives best within an optimum temperature range of 15 to 25 ºC.

There was significantly more cocoon produced in combination of BD and VW present in the ratio of 3:1 which may be due to high decrease in C/N, EC, TAP, TKN as well as proper aeration, beneficial microbes and cellulose rich plant matter during vermicomposting (Merta and Raksun, 2024).

The highest number of hatching of *Lampito mauritii* was observed in the combination of buffalo dung (BD) and vegetable waste (VW) in the ratio 3:1. The incorporating vegetable waste into the feed can boost the total number of earthworm and promote better growth (Merta and Raksun, 2024). The substrate with balance carbon-nitrogen ratio and adequate organic matter content can enhance fecundity and hatching success of earthworm (Tripathi and Bhardwaj, 2004b).

The combination of BD and VW likely provides and optimal environment for the growth of earthworm by supplying essential nutrients and maintaining suitable moisture level (Siddiqui and Singh 2023). Animal dung combined with vegetable waste was found to be the best combination for the reproduction of earthworm (Sharma and Garg, 2011; Merta and Raksun, 2024; Siddiqui and Singh, 2023a and 2023b).

CONCLUSIONS

The earthworms are major soil fauna which feed an organic substance. Through the recycling of organic wastes, earthworms maintain the soil fertility along with rich diversity of useful microbes. The vermicomposting is a suitable tool for proper waste management and production of vermicompost. The in-situ application of earthworm is necessary for the maintenance of soil fertility and recycling of agricultural organic wastes. The study also highlights the potential of different ratio of BD, VW and BP is a suitable feed material for proper growth and development of earthworm population.

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Conflict of interest

The author declares no conflicts of interest regarding the publication of this paper.

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