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Treatment of textile mill dye sludge by vermicomposting using *Perionyx excavatus* species

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Abstract: The accumulation of solid waste sludge from Textile dye sludge causes a great problem in its safe disposal. *Perionyx excavatus* were cultured under laboratory condition with 60-80%moisture in mud pot container following with the mixing ratio of TMS (Textile Mill Sludge) + SD(Sawdust) designated as X (1:1) respectively add inoculums (EM) Effective microorganisms and (CD) Cow dung were also used in the above ratio. Once in 15days up to 90days number of hatchling, worm growth rate and the weight of earthworms were determined and analysed statistically. On the basic of the efficiency of four treatments with control condition, (EM) separately, (CD) separately and (EM+SD) combined together were analysed to support the reproduction and growth of *Perionyx excavatus* has been done. The growth rate, weight gain, and hatchling production observed in the mixed ratio of TMS+SD (1:1) ratio with the above treatments were determined and better combination of mixed ratio with appropriated inoculums was determined. The mixed of TMS+SD+(EM+CD) gave high growth rate, weight gain and hatchling production of selected vermiculture *Perionyx excavatus*. Hence TMS in combination SD in (1:1ratio) can be used for vermiculture.

Key words: Hatchling; Growth reproduction; *Perionyx excavatus;* cow dung; Textile mill dye sludge

Introduction

Textile industries are one of the biggest users of water and complex chemicals during textile processing at various processing stages. Now-a-days, the demand of textile products have increased dramatically and the latter caused proportional increase in textile industry and its wastewaters in India. There are more than 800 dyeing, bleaching and textile processing industries in Tiruppur that generate over 1, 00,000 m^3/day of textile effluent (Ranganathan *et al.,* 2007).

The authors have observed that due to the prohibitive cost of sludge disposal most of the textile mills in India dispose of the sludge in agricultural fields, open dumps, along the roadside or railway tracks and poorly designed sanitary landfills which can pollute surface or ground water causing public health hazards. Apart from this, such practices entail wastage of organic and inorganic nutrients presents in the sludge that might be put to good use (Elvira *et al.,* 1985).

Meanwhile the unavailability of land, stringent national waste disposal standards and public consciousness have made dumps and landfills increasingly expensive and impractical (Ndegwaand Thompson *et al.,* 2001). Industrial effluents are one of the major causes of environmental pollution, because effluents discharged from dyeing industries are highly coloured with a large amount of suspended organic solid (Sun *et al.,* 2003).

The Indian epigeic compost earthworm *Perionyx excavatus* was originally described by (Perrier *et al.,* 1872) and more extensively the life cycle of this species has been studies by various authors under controlled conditions (Hallatt *et al.,* 1990; Kale *et al.,* 1992; Reinecke *et al.,* 1992). This species is considered as a potential waste decomposer by (Loehr *et al.,* 1984). This tropical earthworm is extremely prolific and effectively used in India for vermiculture of organic wastes (Ismail *et al.,* 1997; Bhattacharee *et al.,* 2002).

Materials and Methods

Textile Mill Sludge (Secondary Sludge)

The Textile dye sludge was collected from Textile mill industry in Sivasakthi Textile Mill, Tiruppur, Tiruppur district, Tamil Nadu, India. The sludge collected was the secondary sludge from the decanter unit of the treatment plant.

Agro- industry (Sawdust)

The Saw Dust (SD) was collected from the nearby Ranga saw mill located in Chidambaram, Cuddalore district, Tamil Nadu, India.

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Cow dung

The cow dung (CD) was collected from the local dairy farm in Sivapuri, Cuddaloare district, Tamil Nadu, India

Effective microorganism (EM)

Microbial inoculum used in this investigation was obtained from Institute of Microbial Technology (IMTECH), Chandigarh. This microbial inoculum is commercially available by the name Maple1. The microbial inoculum was prepared as prescribed by the manufacture. EM was used in the composting process as a inoculums to accelerate the processes. The precise composting of the preparation is not classified, but mention is made of Lactobacillus, Saccharomyces and pseudomonas.

Growth and reproduction of *Perionyx excavatus* in organic wastes

In the present investigation, on the basis of trial study of TMS + SD feed mixtures (1:1) ratio were prepared with the inoculums represented in **Table 1** for the sake of convenience, the experiments conducted with different proportions of TMS + SD feed mixtures are designated as X.

In each treatment 1kg substrate was prepared mixed using well water, so as to have 60%-70% moisture. The feed mixtures were transferred to separate mud troughs (40cm diameter x 12cm depth). The **Fig.1** represents the treatments (XP1-XP4). Experimental was carried out on triplicate basic of A, B, C. Since initial decomposition was found to improve food acceptability by worms (Edwards and Bohen *et al.,* 1996) the feed substrates in the troughs were allowed 1% days for initial decomposition.

Table 1: Detailed of the amendment used in Vermicomposting Studies X group

XP1 - TMS + SD
XP2 - TMS + SD (effective microorganisms)
XP3 - TMS + SD (Cow Dung)
XP4 - TMS + SD (EM + CD)

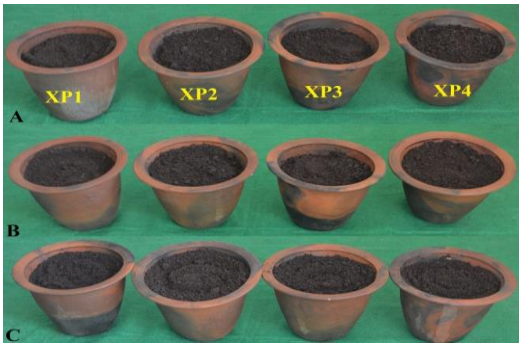

Figure 1: *Perionyx excavatus* growth and reproduction study

Statistical analysis

Earthworm mean biomass, standard error (SE), biomass increase or decrease percentage over control values were calculated. Further, significance of the data was also tested applying student's "t" test.

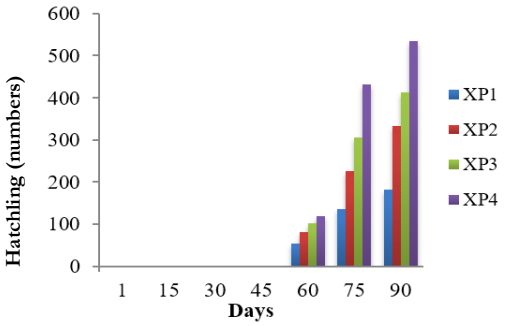

Figure 2: Hatchling production by *Perionyx excavates* Cultured in different proportions of TMS+SD (1:1) X group for a period of 90days.

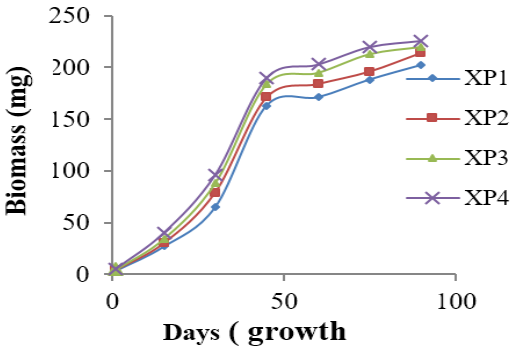

Figure 3: Growth in term of biomass gain by *Perionyx* excavatus cultured in in different proportions of TMS+SD (1:1) X group for a period of 90days.

Table 2: Growth in term of Biomass gain and hatchling production by *Perionyx excavatus* cultured in Textile mill sludge +Saw dust = (1:1) X group

Age of worm (days)	XP1 TMS + SD Control			XP2 TMS + SD + (EM)				XP3 TMS + SD +(CD)				XP4 TMS + SD +(CD+EM)			
	WB (mg)	Growth (mg / worm/ days-1)	HP (No)	WB (mg)	Growth (mg / worm/ days-1)	BID (%)	HP (No)	WB (mg)	Growth (mg / worm/ days-1)	HP (No)	BID (%)	WB (mg)	Growth (mg / worm/ days-1)	HP (No)	BID (%)
1	3.65± 0.027	-	-	4.15± 0.034	-	-	-	4.50± 0.032	-	-	-	4.90± 0.032	-	-	-
15	27 ±0.054	1.83± 0.025	-	31± 0.058	2.11± 0.025	+15.81*	-	33.4± 0.456	1.95± 0.29	+23.7*	-	34± 0.456	2.30± 0.29	+25.92*	-
30	65 ± 0.654	2.67± 0.54	-	73 ± 0.706	2.80 ± 0.055	+12.80*	-	76.2± 1.02	2.65± 0.21	+17.23*	-	80± 1.02	3.47± 0.21	+23.7*	-
45	163 ± 0.541	4.5± 0.024	-	180± 0.577	5.23± 0.065	+10.42*	-	185.6± 0.33	6.12± 0.213	+13.86*	-	192 ± 0.33	6.50± 0.213	17.26*	-
60	171 ± 0.654	1.21± 0.034	53± 2.50	187± 0.896	1.6± 0.056	+9.35*	80± 2.43	190.3± 1.40	0.89± 0.034	+11.28*	102± 2.50	198± 1.40	1.08± 0.034	+15.78*	118 ± 2.43
75	188 ± 1.33	0.54± 0.60	136± 26.0	204 ± 1.33	0.73± 0.005	+8.51*	226± 4.23	208± 0.24	0.64± 0.054	+10.63*	306± 2.62	213± 0.24	0.79± 0.054	+13.30*	431± 4.23
90	202 ± 0.074	0.25± 0.050	181±1.87	216± 0.881	0.34± 0.050	+6.93*	334± 5.34	220± 2.487	0.10± 0.014	+8.91*	412± 1.87	226± 2.32	0.15± 0.014	+11.88*	534± 5.34
THP			**370**				**640**				**820**				**1083**

Values are mean of 30 observation ±S.E
WB- Worm biomass
THP – Total hatchlings production
NS – Not significant (P> 0.05)

*- Significant at 5% level (p<0.05)
BID – Biomass increases or decreases over control
HP – Hatchling production

Results and Discussion

The results revealed that *Perionyx excavatus* produce more number of hatchlings in 1:1 ratio of XP4, TMS+SD+(EM +CD) in the order of hatchling represented in **fig. 2**. The data on total number of hatchlings produced in XP1-XP4 by *Perionyx excavatus* upto 90days could be ranked in the following steps: XP4>XP3> XP2>XP1 as Shown in Figure 2.

The growth rate has been considered as a good comparative index to compare the growth of earthworms in different feeds. Comparison of growth rate (mg/ worm/ day) values of *Perionyx excavatus* indicated that on 45th days *Perionyx excavatus* recorded maximum mean growth rate of 6. 50mg/worm/day in XP4. Further, the worms showed higher growth rate upto 45 days there after the growth rate declined upto 90days in all the treatments (XP1-XP4).

The mean biomass of inoculated *Perionyx excavatus* hatchling was about 4. 90mg. Different inoculums mixed with TMS + SD feed mixtures differentially influenced the growth and reproduction of *Perionyx excavatus*. The body weight of *Perionyx excavatus*. Increased continuously upto 90days in all the four treatments.

The comparison of the biomass increases or decreases over control (BID) values between experimental groups also confirmed the efficiency of(BID) in 1:1 ratio of XP4 TMS+SD+ (EM +CD) feed mixture on worm growth. BID indicated that in XP4, the biomass of *Perionyx excavates* XP4decreased significantly ($p< 0.005$) (barring 45^{th} and 60^{th} days value) represent in **Table 2 & Fig. 3.**

Conclusion

The result indicated that *Perionyx excavatus* gained lesser weight in XP3, XP2 and XP1 and more weight in XP4 for all the periods on the 90 days. *Perionyx excavatus* recorded (XP1) 202±0.019mg, (XP2) 214±0.881mg, (XP3) 220±2.487mg, (XP4) 226±2.320mg, respectively. The overall results confirmed that among the four treatments ultimately mixed ratio of XP4 1:1 TMS + SD + (EM +CD) was found to be supporting maximum biomass gain, high growth rate and maximum number of hatchlings production of *Perionyx excavatus*.

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