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Sustainable Yield of Tubificids in the Outdoor Culvert System

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Abstract - An experiment was conducted for 160 days to culture tubificids (aquatic oligochaetes) in a medium containing 35% wheat bran, 25% cow dung, 20% mustard oil cake and 20% fine sand under running water in outdoor culverts (160 x 25 x 10 cm). A harvesting schedule of four different quantities was tested to obtain a sustainable yield. A harvest level of 30 mg·cm^{-2} every 10 days was more sustainable and significantly ($P<0.01$) better than other levels tested, with total production of 852.42 ± 4.13 mg·cm^{-2} of tubificids.

Few studies have dealt with the culture potential of tubificids (e.g., Kosiorek 1974; Marian and Pandian 1984, 1985; Marian et al. 1989; Mollah and Ahamed 1989). Recently Ahamed and Mollah (1992) described a technique for culturing tubificids using wheat bran, mustard oil cake, cow dung and fine sand. Production was 419.4 mg·cm^{-2}, which is more than twice that reported previously (Marian and Pandian 1984). During the experiments by Ahamed and Mollah (1992) it was observed that the culture could not be continued after a certain period due to overpopulation which led to decrease in the growth of tubificids. The present initiative was taken to establish the sustainable yield of tubificids on the basis of the previous work of Ahamed and Mollah (1992).

Twelve outdoor cemented culverts (160 x 25 x 10 cm) constructed in a shaded area and protected from rain and sunlight were divided into four groups (I-IV) each with three replications. Culverts were connected by a stopcock to a water tank fed with water from a deep well. Tubificids (seed) were collected from Bangladesh Agricultural University campus. Species of *Limnodrilus,* *Branchura, Tubifex,* etc. were the major representatives of the tubificids (Mollah and Ahamed 1989). They were washed and kept under tap water in the laboratory for 24 hours before inoculation. Media were prepared by mixing 35% wheat bran, 25% cow dung, 20% mustard oil cake and 20% fine sand in a little water. The mixture was kept in this form for three days before being placed in the culture culverts and mixed twice daily to enhance decomposition.

Media were introduced 10 days apart at the rate of 250 $mg{\cdot}cm^{-2}$. Continuous water flow was adjusted through the porous PVC pipe to each of the culverts at a rate which was able to maintain the dissolved oxygen above 3 $mg{\cdot}l^{-1}$ in the culture system. After 24 hours of placing the media, tubificids were inoculated at the rate of 0.75 $mg{\cdot}cm^{-2}$ (i.e., 3 g/culvert) and spread homogeneously over the media. Water depth over the media was maintained at 3 cm by a depth regulator. Schedules of harvest size for groups I, II, III and IV were 10, 20, 30 and 40 $mg{\cdot}cm^{-2}$ every 10 days, respectively. Standing biomass was recorded every 10 days from the 50th day of experiment according to Ahamed and Mollah (1992).

The data obtained by total calculated production (i.e., cumulative harvest + standing biomass of 160th day) were statistically analyzed following the principle of completely randomized design. Mean values were compared according to Duncan's New Multiple Range test at the 5% probability level.

The standing biomass and production of tubificids in culture system are shown in Tables 1 and 2, respectively. ANOVA test results indicated that there was significant difference in mean total calculated productions among the four different treatments (Table 3). Total calculated production of each treatment was significantly different from others with the highest production in treatment III and the lowest in treatment I (Table 2).

During the culture period, dissolved oxygen was recorded to be 3.1 ± 0.8 mg/l.

The results showed that treatments I and II were underharvested because their standing biomass increased gradually and exceeded the carrying capacity of the culture system. Tubificid population collapses followed (Fig. 1), usually following the introduction of media when the rate of decomposition of the media was comparatively high. Treatment IV was overharvested; the standing biomass decreased over time (Fig. 1). Treatment III showed a more

Table 1. Standing biomass (mg·cm^{-2}) of the tubificid worms at different times of the 160-day experimental period (each value represents the mean (±SD) of three observations).

Treatments	Experimental period in days											
	50	60	70	80	90	100	110	120	130	140	150	160
I	303.57 ± 7.10	430.43 ± 5.23	505.35 ± 3.12	567.27 ± 7.08	367.32 ± 16.21	380.62 ± 4.93	430.51 ± 2.78	480.62 ± 6.44	560.35 ± 8.62	435.24 ± 19.62	440.49 ± 8.02	459.23 ± 10.60
II	301.42 ± 9.12	390.67 ± 7.62	465.82 ± 4.23	494.43 ± 2.75	520.42 ± 4.92	530.62 ± 6.26	535.24 ± 5.08	560.65 ± 7.12	580.71 ± 3.42	410.48 ± 21.30	418.62 ± 5.13	430.90 ± 13.08
III	300.63 ± 4.45	360.76 ± 3.78	415.45 ± 6.32	450.62 ± 5.38	465.43 ± 5.02	470.67 ± 3.48	472.55 ± 5.36	474.44 ± 8.42	475.27 ± 2.92	480.15 ± 7.21	483.21 ± 4.82	492.43 ± 4.13
IV	303.41 ± 5.38	325.51 ± 9.82	334.73 ± 4.43	332.84 ± 5.04	324.24 ± 2.78	304.85 ± 5.23	275.13 ± 8.32	256.23 ± 5.91	249.36 ± 5.63	252.45 ± 8.51	285.32 ± 5.67	291.80 ± 2.24

Table 2. Total calculated tubificid production over 160 days.

Treatments	Standing biomass of 160th day (S) mg·cm^{-2}	Harvested biomass in 160 days (H) mg·cm^{-2}	Total calculated production (S+H) mg·cm^{-2}
I	459.23 ± 10.60	120	579.23 ± 10.60 d
II	430.90 ± 130.08	240	670.90 ± 13.08 c
III	492.43 ± 4.13	360	852.43 ± 4.13 a
IV	291.80 ± 2.24	480	771.80 ± 2.24 b

Figures followed by different superscripts in the same column differ significantly ($P<0.05$) when compared on the basis of Duncan's New Multiple Range test.

Table 3. ANOVA table for mean total calculated production (mg·cm^{-2}) of tubificids at 160 days experimental period.

Sources of variation	Degrees of freedom	Sum of squares	Mean square	F value
Replications	2	49.147	24.5735	3.59203 NS
Treatments/between groups	3	127319.880	42439.9590	6203.67 **
Errors/within groups	6	41.047	6.8411	
Total	11	127410.070		

**Highly significant at 1% level of probability.
NSNot significant at 5% level of probability.

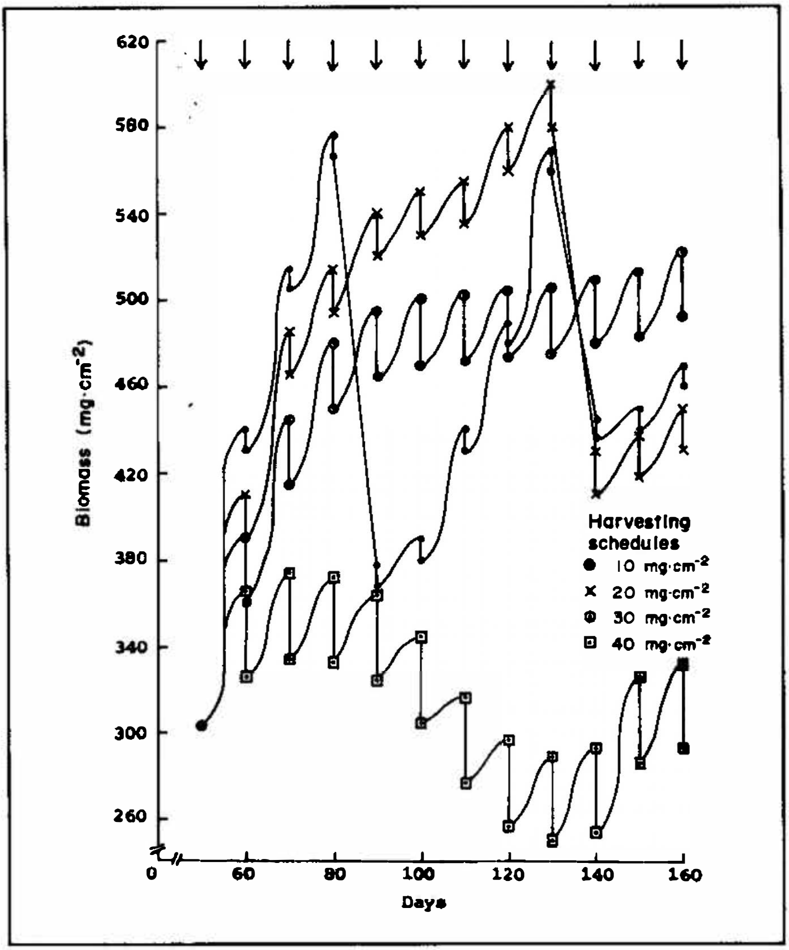

Fig. 1. Harvest, standing biomass (mg·cm^{-2}) and recruitment of tubificid worms at different times of 160-day experimental period. Arrows indicate the time of harvest.

or less sustainable condition. The standing biomass of this treatment was not hampered by harvesting at the rate of 30 $mg \cdot cm^{-2}$ every 10 days. This was considered an optimal and balanced level.

The highest production was 852.43 $mg \cdot cm^{-2}$ tubificids in 160 days. This value is comparable with that of 580 $mg \cdot cm^{-2}$ in 120 days reported by Marian and Pandian (1984). Comparison of the production rate of these worms revealed that the media used is better than fresh cow dung. The present study required 3.5 g of raw materials for 1 g worm production against 18 g and 25 g cow dung reported by Marian and Pandian (1984) and Marian et al. (1989) respectively.

The calculated production cost of tubificids during the present experiment is comparable to that of manufacturing inanimate feeds. Except for water costs, only Tk. 10-12 (approximately US$ 0.35) are needed to produce 1 kg worms.

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