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OPTIMUM HARVEST FOR SUSTAINABLE YIELD OF FISH LIVE FOOD TUBIFICID WORMS

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Abstract

The Optimum harvest suitable for sustainable yield of tubificid worms without affecting the future yield for a period of 60 days was determined. The media ingredients used to culture the worms were 20% wheat bran, 30% soybean meal, 20% mustard oil cake, 20% cow dung and 10% sand. A harvest level of 50 mg/cm^2 (maximum yield; 518.93 ± 14.36 mg/cm^2) at ten days interval starting from 30 days of worms' inoculation was found suitable for sustainable yield in the later sampling durations. Results of this study have implications in increasing fish yield by producing reliable and sustainable yield of fish live foods tubificid worms.

Introduction

Tubificid worms have been found to be one of the best qualities live foods in rearing the larvae of hatchery produced catfishes, prawn and ornamental fishes. Catfishes contribute nearly 2.41% of total inland fish production in Bangladesh.(1) Farming of shing *Heteropneustes fossilis*, magur *Clarias batrachus*, pabda *Ompok* spp., pangas *Pangasius hypophthalmus*, prawn *Macrobachium rosenbergii* etc. is becoming progressively more important as cash animals in Bangladesh mostly in Mymensingh area. Production and consistent supply of good quality fingerlings in sufficient quantity are essential to sustain this section of aquaculture industry. However, reliable supply of required quantity of live foods such as tubificid worms is still a bottleneck in the rearing processes of catfish fry and fingerlings. The quality of good seed largely depends on the proper feed management in which production of live foods in particular the tubificid worms in the rearing of catfish larvae is important.

Live foods enhance the growth and survival rates of juvenile catfishes, crustacean and ornamental fishes.(2) Significantly higher survival rates and ten-times extra growth was found in catfish *Clarias batrachus* larvae fed tubificid worms over those formulated dry feed.(3) Similar growth rate was detected in *C. batrachus* and *C. gariepinus* larvae rearing using tubificid worms.(4,5) White sturgeon (*Acipenser transmontanus*) grew 40% larger on tubificid worms compared to inanimate pellets.(6) The tubificid worms have become an important component in commercial aquaculture as a live food source because of their high food values (5575/calg dry matter basis).(7,8) They grow in a place

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with steady and continuous water flow with high organic detritus. The current total supply of these worms comes from wild harvests which are unreliable and inadequate in terms of demand. Harvest from the wild is hazardous to collect for unhealthy conditions. Information related to culture and sustainable production of tubificid worms in Bangladesh is meagre. Little success has been reported of several attempts to develop a technique to culture tubificid worms.[9-10]

Thus there is a need to develop a technique suitable to get reliable supply meeting the growing demand. Therefore, the present study was undertaken with a view to determining the suitable harvest level for sustainable yield of tubificid worms.

Materials and Methods

Tubificid worms were collected from different places of Mymensingh and cleaned by water flow and held in a flow-through-system. The worms were conditioned for 24 hours before inoculation into the culture culverts. The experiment was conducted between April and June, 2009 for 60 days.

The worms were cultured in indoor cemented culverts ($160 \times 25 \times 10$ cm^3) system to protect them from rain and sunlight or any other natural hazards. At the beginning of the experiment, the culverts were washed and cleaned with fresh water. The culverts were connected with a flow-through-system in which subsurface well water was used. Each culvert was given continuous water spray by using a horizontal porous PVC pipe (180 cm long and 1 cm^2 diameter). The experiment was conducted in the Department of Fisheries Biology and Genetics, Bangladesh Agricultural University, Mymensingh.

A 4×4 factorial design was employed in triplicates to study the effects of four different harvest levels (30, 40, 50 and 60 mg/cm^2) and four sampling durations (30, 40, 50 and 60 day) for the sustainable yield of tubificid worms.

The ingredients wheat bran (20%), soybean meal (30%), mustard oil cake (20%), cow-dung (20%) and 10% sand were used. The ingredients were mixed with water to get wet for a period of seven days for enhanced decomposition. Successive mixing was done twice a day for better mineralization.

Culture media were placed and water flow was adjusted 24 hours before inoculation of worms to the culverts. The collected tubificid worms were inoculated at the rate of 2.5 mg/cm^2 (i.e. 10 cg/culvert). They were spread over the media homogeneously as much as possible in each culvert.

Continuous water flow was maintained which was able to keep the dissolved oxygen in suitable range (4-6 mg/cm^2). The water flow rate was maintained by adjustment stop cork of PVC pipes.

The periodic supply of culture media was done after 10 days of worms' inoculation. The prepared media were introduced at the rate of 250 mg/cm^2 in respective culverts once in every 10 days at 10.00 a.m. before sampling. Total quantity of media was spread through out the culverts. At that time, water flow was stopped for a while.

Water flow rate (L/min) was measured once in ten days. Water temperature (ºC) of the culture culverts and dissolved oxygen (mg/l) was detected with the help of a portable dissolved oxygen meter (Jenway, Model No. 9070, UK) before sampling at 10.00 a.m. once in every 10 days.

Samples were drawn at 30, 40, 50 and 60 day of 60 days culture duration. Samples were collected by using a sampler (4.4 × 4.4 cm^2) with water and media from five randomly selected places of each culvert. The worms were cleared by flowing water and separated with a pair of forceps and dropper from the unwanted particles. Cleaned tubificid worms were dried with blotting paper and weighed by Matler electric balance (Switzerland) graduated in 0.000 g.

Data were analyzed by using ANOVA followed by Tukey's HSD post hoc for multiple comparisons. Data have been presented as mean ± SEM and analyzed by using the statistical software SPSS version 11.5 with the level of significance at $p < 0.05$.

Results and Discussion

This experiment was conducted to determine the sustainability of the culture of tubificid worms by harvesting suitable quantity so that the post harvest population can remain unaffected for future harvests. It was observed that 50 mg/cm^2 harvest resulted in the best yield (379.00 ± 40.95 mg/cm^2) while 60 mg/cm^2 did the lowest (216.48 ± 25.64 mg cm^{-2}; Fig. 1). Harvests of 30 and 40 mg cm^{-2} had similar effects on the population growth which was significantly lower than in 50 mg/cm^2 and higher than did 60 mg/cm^2 harvests. While culture durations were compared, 60 day sampling had the highest yield of worms (395.58 ± 26.03 mg/cm^2) which was 2.91-folds higher than that of the harvest of the first sampling that was the lowest (135.76 ± 9.49 mg/cm^2) observed in 30 day sampling (Fig. 2). Yield of 50 day sampling (357.25 ± 22.72 mg/cm^2) was similar but significantly higher than that of 40 day sampling (294.39 ± 20.52 mg/cm^2).

In case of sustainable yield of tubificid worms, the observed highest yield was found for the overall effects of different harvest levels when the harvest level was 50 mg/cm^2 at a 60-day-sampling.

The highest 518.93 ± 14.36 mg/cm^2 was found at 60 day sampling when the sample size was 50 mg cm^{-2} worms (Fig. 3a-d). In 30 mg/cm^2 sample, harvest level had similar trend at 40, 50 and 60-day-sampling but 30 day yield was significantly different from others. In harvest level 40 mg cm^{-2}, the highest yield was found at 60 day had similar to 50 day yield but different from 30 and 40-day-yield. On the other hand, the harvest level of 60 mg/cm^2 showed similar trends at 50 and 60-day-yields.

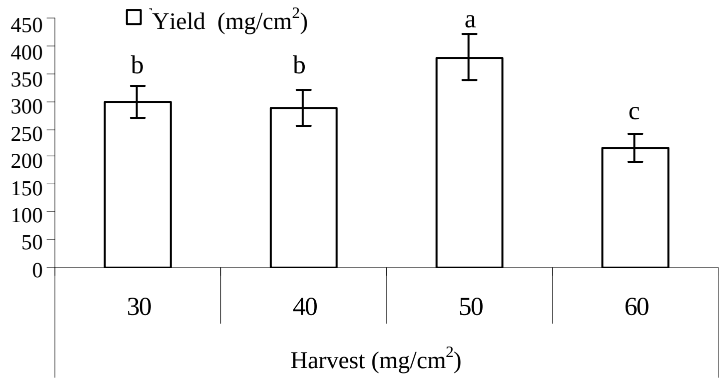

Fig. 1. Yield of tubificid worms after harvesting 30, 40, 50 and 60 mg/cm^2 across all four sampling durations (30, 40, 50 and 60 days). Bars (± SEM) with different super script letters indicate significant differences (ANOVA, HSD; $p < 0.05$).

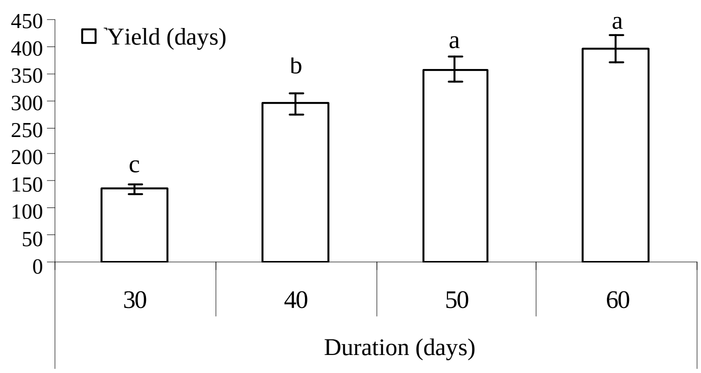

Fig. 2. Yield of tubificid worms sampled 30, 40, 50 and 60 days after inoculation across all four harvest levels (30, 40, 50 and 60 mg/cm^2). Bars (± SEM) with different super script letters are significantly different (ANOVA, HSD; $p < 0.05$).

The observed maximum standing yield (518.93 mg/cm^2) over 60 days culture was found in the media treatment (20% WB, 30% SM, 20% MOC, 20% CD and 10% sand) when 50 mg/cm^2 worms have been harvested at every ten days interval. It has clearly been proved the suitability of the quantity to be harvested to maintain the post-harvest population that could be sustainable for future harvest. A little bit higher yield (852.43 mg/cm^2) has been found[10] than the yield of present study by harvesting 30 mg/cm^2 with same harvest interval but they needed 2.67-folds longer duration which of course makes the study impractical and economically nonviable. Because cost associated with additional culture duration over 100 days has resulted only 134 mg/cm^2 yield which clearly demonstrates the unsuitability of this harvest level and also culture duration.

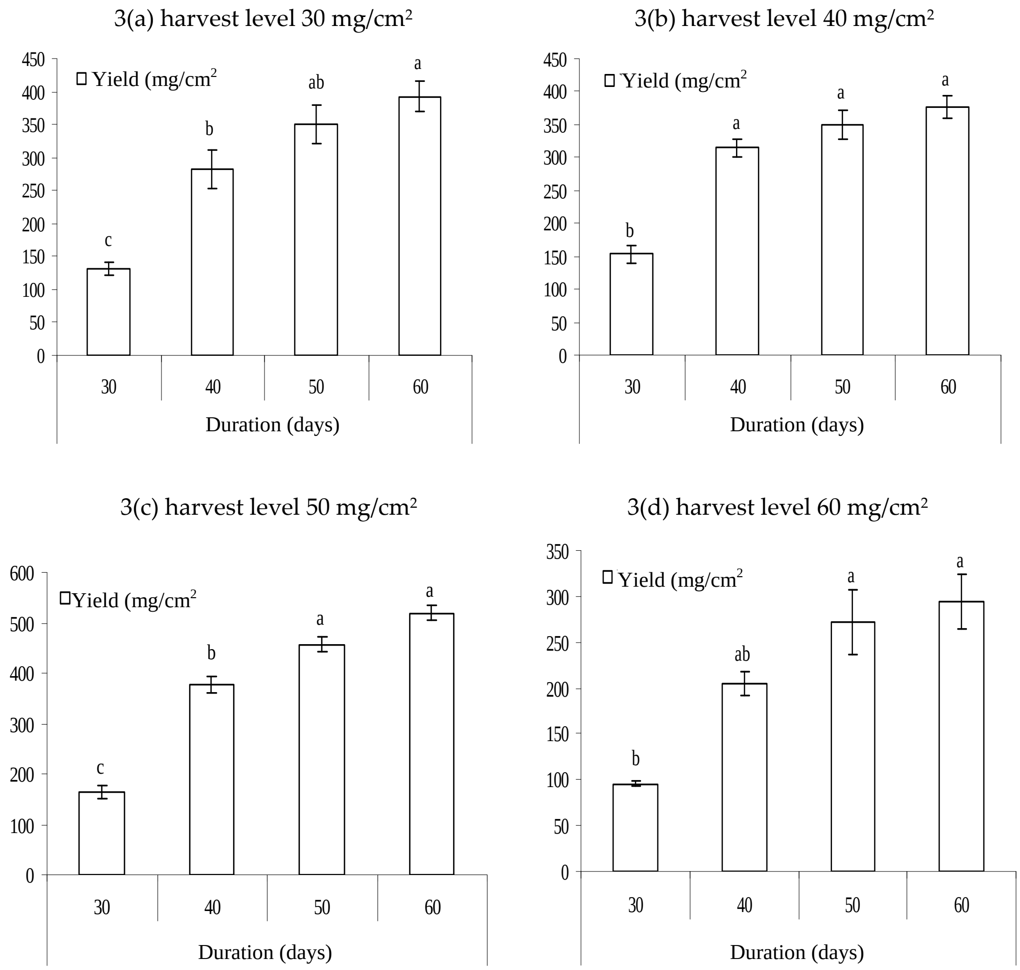

Fig. 3(a-d). Yield of tubificid worms sampled 30, 40, 50 and 60 days after inoculation across all four harvests (30, 40, 50 and 60 mg/cm²) to determine the suitable harvest to maintain the sustainable population for future unaffected harvest. Bars (± SEM) with different super script letters are significantly different (ANOVA, HSD; $p < 0.05$).

The observed results showed that the harvest levels 30 mg/cm² and 40 mg/cm² were under-harvested because their initial standing biomass was gradually increased and then reached the carrying capacity of the culture system. And just after exceeding the level of carrying capacity of the culture system, the production of both treatments dropped because of sudden death of a considerable number of tubificid worms. The death might have occurred due to oxygen depletion (2.1 mg/l). The tubificid population usually distorted after the introduction of the media when the rate of decomposition of media was comparatively high needing enormous amount of oxygen. On the other hand, the harvest levels 60 mg/cm² was over harvested because the remaining biomass decreased over the harvesting periods. Across the four treatments tested, the harvest levels 50 mg/cm^2 showed more sustainable condition than others. The remaining biomass was not affected in 50 mg/cm^2 harvest level.

The total yield 718.93 ± 14.36 mg/cm^2 of tubificid worms (harvested yield 200 mg/cm^2 and standing yield 518.93 ± 14.36 mg/cm^2) was found in 50 mg/cm^2 harvest level that was higher than that of harvest level 30, 40 and 60 mg cm^{-2} at 60 days culture (Fig. 4).

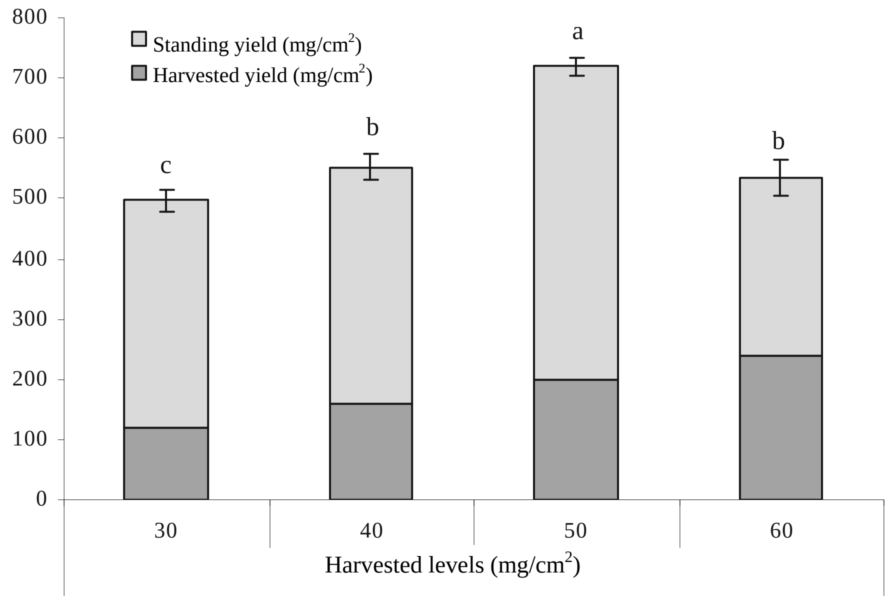

Fig. 4. Total yield of tubificid worms in different harvest levels (30, 40, 50 and 60 mg cm^{-2}) for over 60 days culture period. Bars (± SEM) with different super script letters are significantly different (ANOVA, HSD; $p<0.05$).

Temperature of the culverts water was ranged from 22 to 26°C throughout the study period. Water flow rate (1.14 - 1.30 L/min) maintained the DO levels between 4 and 6 mg L^{-1}. In the entire experiment, the observed water temperature (22 to 26°C) and dissolved oxygen (4 to 6 mg/L) indicates optimum limit with the water flow rate of 1.14 to1.30 L/min.(11) The whole life cycle of *Tubifex tubifex* to be 100 to 123, 70 to 90 and 28 to 64 days at 15, 20 and 25°C environment temperature, respectively, hafd been studied earlier. (12) While 11.0°C is the minimum temperature for the reproduction of *T. tubifex*, 2.5 and 38.0°C are lethal. (13)

The result has shown that 50 mg/cm^2 can be considered as the optimal and balanced harvest level to get the sustainable production of tubificid worms in the future harvest.

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