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Effect of Waste Decomposer- Pure Microbial Strains Obtained from Desi Cow Dung on the Growth and Performance of Genetically Improved Farmed Tilapia (*Oreochromis niloticus*)

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ABSTRACT

The effects of waste decomposer (pure microbial strain obtained from desi cow dung) and raw cow dung on the growth and production performance of genetically improved farmed Tilapia (GIFT) were evaluated in nine earthen ponds at Cholamadevi, Ariyalur for a period of 120 d. Three treatments namely T1 (raw cow dung), T2 (pure microbial strains) and T3 control (with no fertilization) with three replicates were tested. GIFT was used as experimental species and stocking density was 8 fishes/m^2. The range of water quality parameters were found to be within the production range and had no significant (P>0.05) difference among the treatments. However, significant difference (P<0.05) was observed in case of weight gain and total production among the treatment. The highest mean weight (g) gain was obtained in T2 (235.5±0.42) followed by T1 (220.8±4.37) similarly the highest production (kg/ha/120days) was obtained in T2 (2796.57 kg) followed by T1 (2649.6 kg). The present study showed that the growth and production performance of GIFT were higher in T2 compared to other treatments. Though, no significant different was observed among T1 and T2 in growth and production performance, the use of pure microbial strain in form of waste decomposer, showed better economic impact in form of high BC ratio and less FCR compared to that of T1. Hence, it could be a better alternative for farmers who lack livestock for production of cow dung. Since direct microbial strain were used for fertilization, the time required for growth of phytoplankton was also reduced and growth of the good microbial organism is also enhanced causing better immunity and feed conversion in fishes reared in this pond. Further study should be needed to evaluate the use of pure microbial strains in polyculture system of carp fish which is also predominately practiced in this district

Key Words: Aquaculture, Decomposer, Microbial strain, Cow dung, Waste.

INTRODUCTION

Inland fisheries are one of the major sources of income to the farmers in this district. Ariyalur district comprises of six blocks with total fish production of 2125 t and nearly 633 farmers and their family members are involved in this enterprise (The district Statistical book, 2018-2019). Although, most of the farm ponds are 800 m^2-1000 m^2 in size, collectively these farm ponds are the potential resources to enhance the fish production of the district.

Rearing genetically improved farmed Tilapia (GIFT) culture has become one of the most important aquaculture trading businesses because of their high biomass yield per unit area as a result of higher stocking density (Basha *et al,* 2013). Hence, introduction of GIFT for higher production was carried out in Ariyalur district to solve the problem of lower growth rate and prolonged growth period of conventional carps. Nevertheless, intensive production practices find to be more stressful for fishes, resulting in poor metabolic ability (Pankhurst *et al,* 2008; Santos *et al,* 2010), poor meat quality and highly susceptible to diseases (Bulfon *et al,* 2013)

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To maintain the good health of cultured fish and maximize production in intensive production systems, fish farmers started using antibiotics and other chemicals to prevent mortality and sustain production. Repeated use of antibiotics causes hepatotoxicity (Thiim and Friedman, 2003), antibiotic resistance in fish pathogens, environmental pollution, and accumulation of residues in fish tissues, causing potential harm to public health in its consumers (Serrano, 2005). In the new era of the market, there is an increase in demand for safe and good quality fish products which are free from antibiotics and other pollutants (Ji *et al,* 2007). Hence, the need to replace antibiotics and other synthetic chemicals with dietary supplements on ingredients that can enhance fish health, growth, feed utilization capability, and ultimately ensure safety and good quality aquatic production from aquaculture is becoming increasingly vital.

The raw cattle dung and poultry dropping had the widest application for fish culture as organic manure over decades in India, South-east Asian other countries. Cow dung is commonly used as fertilizer for fish ponds but fish production is limited to 1500-2000 kg/ha. (Tripathi and Karma, 2001). These yields can however be more than doubled if the pure microbial strain obtained from dung alone is used instead of raw dung. Soluble organic matter supplied to ponds by using manure like cow dung stimulated phytoplankton growth. Moreover, it also increases the biomass of zooplankton and benthic organisms. The periphyton based aquaculture system could enhance the production by several folds compared to the conventional culture system. Thus, making the periphyton based aquaculture system more nutrient efficient (Bhuyan *et al,* 2020)

As an alternative to currently available, commercial biocontrol agents and biofertilizers, waste decomposer was released for the farmers by National Centre of Organic Farming for enhancing the crop productivity and plant disease management. The waste decomposer is a consortium of few beneficial bacteria, isolated from desi cow dung and can be easily multiplied with jaggary at farmer level. The waste decomposer exhibits multifaceted uses in agriculture including in situ composting of crop residues, quick composting of organic wastes, seed dressing, soil irrigate, bio-control agent, bio-fertilizer, soil health reviver, etc. It is bestowed with virtues such as low cost, easier multiplication, fast growth rate, superior shelf life and broad spectrum activity on phyto-pathogens. The jaggary propagated waste decomposer indicated the presence of cellulolytic, phosphate and potassium solubilizing; siderophore producing bacteria on selective culture media. The consortium is also abundant in nitrogen fixing bacteria (Azotobacter, Azospirillum, Rhizobium, Acetobacter) and Pseudomonas fluorescence (Kora, 2022).

Therefore, it was necessary to address the use of waste decomposer (pure microbial strains obtained from cow dung) to enhance fish production with low-cost input and a pollution-free environment. The present study was undertaken to observe the effect of low-cost organic fertilizers and feed ingredients on the growth and production of GIFT in intensive culture.

MATERIALS AND METHODS

The experiment was carried out during the period from March 2020 to June 2020 (120 d) in three earthen ponds, situated in and around, Cholamadevi village, Ariyalur district, Tamil Nadu. GIFT seeds were sourced from Barur Centre for sustainable aquaculture, Krishnagiri, Tamilnadu. Average size of the seeds stocked was 3 cm and 3-3.5g weight. Fishes were stocked at the rate of 8 fishes per m^2.

Fertilization regime

The experiment was conducted for a period of 120 d in nine earthen ponds in triplicates using completely randomized design. Out of nine ponds, first three ponds were provided with cow dung as fertilizer (T1): the ponds were fertilized 2 weeks before the fishes were stocked into ponds, to ensure that production of plankton and other organisms.

Application was done once a week @ cattle manure at 1200 kg/ha/week in the morning hours (Green and Boyd, 1995).

The second three ponds were provided with pure microbial strains in the form of waste decomposer @ 500 l/ha/week (T2): The waste decomposer solution was prepared by adding 5 kg of jaggary in 500 litres of fresh water in a barrel and after complete dissolving of jaggary, 50 g waste decomposer (NCOF, Ghaziabad) was added and the entire preparation was kept closed for 1 week for fermentation with continue stirring daily before use (Chandra *et al,* 2019). The last three ponds were not provided with any fertilizer and were treated as control (T3).

Pond preparation

The ponds were prepared according to the method previously described by Adarsha *et al* (2020) with slight modification. Briefly, prior to start of the experiment, all the tanks were cleaned properly and exposed to sunlight for few days until the bottom mud got cracked. Further, after estimation of pH, quicklime (CaO) was applied @ 2000 kg/ha in three phases (once before stocking and twice post stocking). Inorganic fertilizers were not used in any of the ponds.

Feeding

Fish were fed at the rate of 3 per cent of their body weight with an artificial feed containing a mixture of rice bran (RB) and groundnut oil cake in 1:1 ratio twice daily. Quantity of feed fed was adjusted based on the mean fish biomass of replicate ponds in each treatment, estimated after monthly sampling and considering an assumed survival of 95 per cent

Monitoring of water quality parameter

The physio-chemical parameter of water of all experimental pond were analysed on fortnightly based. Water temperature was recorded using a Celsius thermometer. Dissolved oxygen was determinedly a portable DO meter (YSI model), pH of water was determined by pH meter (Hanna, USA)

Fish growth studies

Sampling was carried at every fortnightly for assessment of growth and health performance. Random fish sampling was collected. The parameters were measured using measuring scale and weighing balance

Weight gain (g): Mean final weight (g) – Mean initial weight (g)

$$\text{Survival rate (\%)}: \frac{\text{No. of fish harvested}}{\text{No. of fish stocked}} \times 100$$

Production: No. of fish harvested x Final weight of fish

Statistical analysis

The parameters were statistically analysed using one way ANOVA and computer analysis of the data was done using the software SPSS (SPSS 11.5) with 5% significance.

RESULTS AND DISCUSSION

pH

pH is an important parameter in inland fish culture and also called the productivity index of a water body. During the study period, the range of pH varying from 6.3 to 8.4, 6.7 to 8.2 and 6.5 to 8.5 in T1, T2, and T3 respectively. The mean values of pH were 7.2±0.33, 7.1±0.32 and 7.5±0.22 in T1, T2 and T3 respectively (Table 1). There was no significant variation of pH values under different treatments. Most natural water has a pH of 6.5 to 89 (Boyd, 1982) which was within the acceptable range required for fish culture 6.5 to 8.5. Water quality in this experiment varied with the type of organic manure applied but did not affect the well-being of the fish.

Dissolved Oxygen (DO) (mg/l)

DO is a critical factor in intensive fish culture and success and failure in fish farming often depend upon it. During the study period, the dissolved

Table 1. Mean value of water parameter under different treatment throughout the study period

Treatment	Parameters		
	pH	Dissolved Oxygen (mg/L)	Temperature (ºC)
T1	7.2±0.33	5.79±0.66	27.42±0.44
T2	7.1±0.32	5.8±0.55	28.7±0.66
T3	7.5±0.22	5.84±0.66	29.07±0.66

oxygen content of the water was found to vary from 4.8 to 6.5 mg/l in T1, 4.95 to 6.7 mg/l in T2, and 5.22 to 6.8 mg/l in T3. The mean values of DO content of the water in treatment T1, T2 and T3 were 5.79±0.66, 5.80±0.55 and 5.84±0.66 (Table 1). The highest DO concentration of 6.8 mg/l was observed in treatment T3 when the weather was sunny and mild breeze was blowing from the southeast. The lowest DO concentration of 4.8 mg/l was observed in T1, while the condition was cloudy and there was overnight rainfall the day before. No significant changes in dissolved oxygen were observed among the treatment. Similar results were reported by Hossain (2000) and Kohinoor (2000)

Temperature (ºC)

During the study period, the water temperature varied from 25.6 to 32.2 ºC in T1, 26.2 to 31.8 ºC and 28.2 to 33.1 ºC in T3 respectively. The mean value of water temperature in T1, T2 and T3 were 27.42±0.44, 28.7±0.66 and 29.07±0.05 respectively (Table 1). The highest temperature was recorded in T3 was due to relatively less phytoplankton load in T3 compared to T1 and T2, where the growth of phytoplankton was high. The lowest temperature (25.6ºC) was recorded in T1 might be due to low intensity of light as a result of rainfall and cloudy condition and cool air flow. The temperature observed in this study appeared to be suitable for fish culture which agreed with the finding of Wahab *et al* (2001).

Growth, survival, and production of fish

Weight gain (g)

No significant difference was observed in case of initial weight of fish fingerling in different treatments. Observation on the growth rate of fishes in various treatment should that in 120 d culture period, the highest weight (g) gain (235.5±0.42g) was attained in treatment T2 with waste decomposer followed by Treatment T1 (220.8±4.37g) with cow dung and in Treatment T3 (190.9±5.62g) (Table 2). There was a significant ($P<0.05$) difference in weight gain among T1 and T3 treatment, T2 and T3 treatment. The present results are supported by Mitra *et al,* 1987 who used natural manure like cow dung in the growth of fishes. From the study, it is found that mean weight gain and percent weight gain was significantly higher in T1 and T2 than in T3. The difference in growth rate might be related to fertilization supplements like cow dung and waste decomposer supplied in the ponds.

Survival rate (%)

The survival (%) of fish was varied among the treatments. The survival (%) of GIFT varies 96.01±1.55 % in T1, 95.7±3.23% in T2, and 94.9±2.71% in T3 (Table 2). There was no significant change in the survival rate. Similar higher survival of GIFT tilapia was recorded by Hossain *et al,* (2004). The higher survival of fish in the present study might be related to the relatively large size of fingerlings (3.5 g) stocked and care taken during the rearing period.

FCR

The FCR values found in T1, T2, and T3 were 1.55±0.11, 1.46±0.21, and 1.72±0.12 respectively. The high FCR values in T3 might be due to the lack of growth of phytoplankton and other beneficiary organism in this treatment group due to lack of regular fertilization of the pond whereas T1 and T2 ponds the growth of algae, phyto and zooplankton growth were abundant hence less feed was required

Table 2. Weight gain, Survival, FCR, production and BCR of fishes.

Treatment	Initial Weight (g)	Final Weight (g)	Weight gain (g)	Survival rate (%)	FCR	BCR	Production (Kg/ha/120 days
T1	3.2±0,33	224±4.7	220.8±4.37	96.01±1.55	1.55±0.11	2.55	2649.6
T2	3.1±0.45	238.6±0.87	235.5±0.42	95.7±3.23	1.46±0.21	2.87	2796.56
T3	3.2±0.33	194.1±5.95	190.9±5.62	94.9±2.71	1.72±0.12	2.23	2266.94

in these group compared to T1. Hossain *et al* (2011) found similar results of FCR values of GIFT tilapia fed on rice bran and commercial tilapia feed.

Benefit Cost (BC) ratio

The BC ratio is an indicator showing the relationship between the relative costs and benefits of the project, expressed in monetary or qualitative terms. The BC ration (Table 2) was found to be highest in T2 (2.87) followed T1 (2.55) and T3 (2.23). The BC ratio was highest T2 is due to the fact highest production (2796.56 kg/ha) and low cost of production involved in purchase of waste decomposer compared to raw cow dung in T1. Though T3 showed less production cost compared to other treatments, the net profit was less due to low production (2266.94 kg/ha) compared to other two treatment. The results were in agreement with previous finding of Utomakili and Aganmwonyi (1995).

Total production (kg/ha/120 days)

The total production of fishes was 2649.6, 2796.56 and 2266.94 kg/ha. in T1, T2 and T3 respectively, and varied significantly among the treatments (Table 2). The highest production found in T2 might be due to the availability of organic matter. The organic matter acts as substrate for the heterotrophic production of microorganisms and protozoans in microbial food webs that can be utilized by fish to obtain the much needed nutrition through natural crops of algae, bacteria and other microorganisms in organically fertilized ponds and this result is similar to the findings of Hossain *et al* (2011).

CONCLUSION

The present research findings revealed that fertilization of farm ponds with pure microbial strains showed better result compared to fertilization with only raw cow dung and with no fertilization at all. The use of pure microbial strains showed better economic results compared to that of using only raw cow dung as fertilizer. Hence, it could be a better alternative for farmers who lack livestock for production of cow dung. Since direct microbial strain were used for fertilization, the time required for growth of phytoplankton was also reduced and growth of the good microbial organism is also enhanced causing better immunity and feed conversion in fishes reared in this pond.

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