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Efficacy of vermicompost as fish pond manure – Effect on water quality and growth of *Cyprinus carpio* (Linn.)

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ABSTRACT

Experiment was conducted in (0.002 ha) cemented tanks for 120 days to assess the efficacy of vermicompost as fish pond manure at a dose of 10,000 kg/ha/year (VC_{10}), 15,000 kg/ha/year (VC_{15}) and 20,000 (VC_{20}) kg/ha/year) in comparison to semi-digested cow dung (8–10 days old), which was utilized at a dose of 20,000 kg/ha/year (CD_{20}). One fourth of the doze was applied 15 days prior to fish stocking and rest in equal weekly installments. Twenty fingerlings of common carp, *Cyprinus carpio* (Linn.) were stocked (10,000/ha) and fed with supplementary diet @ 2% of their body weight daily. Water quality parameters were found to be within the optimum limits for carp culture in all the treatments. Zooplankton production in all the treatments did not differ significantly. Fish growth in terms of weight gain, percent weight gain, specific growth rate and yield was maximum in VC_{15} followed by VC_{20}, VC_{10} and CD_{20}.

1. Introduction

Freshwater aquaculture in India has made significant contribution towards total fish production involving different types and levels of inputs (Ayyappan and Jena, 2003). Among various practices, depending upon the variable inputs, semi-intensive carp culture practices in rural aquaculture involve utilization of various organic manures for plankton (natural food) production. These manures are either directly utilized by the fish or they enrich the aquatic ecosystem with autotrophic (plankton) and heterotrophic microbial communities (Schroeder, 1987; Muendo et al., 2006). Organic manures if not decomposed completely before application in aquaculture pond may deteriorate the water quality as they utilize oxygen during decomposition. Therefore, the amount of any organic manure to be added in the pond mainly depends upon its biological oxygen demand (BOD), as their excessive use may cause severe dissolved oxygen depletion in the pond and results in production of toxic gases like CO_2, H_2S, NH_3, etc., and can spread parasitic diseases (Chakrabarty et al., 2008). Hence, to minimise the harmful effects of organic manures on pond ecosystem, the best alternative is to utilize fully decomposed/digested organic manures in comparison to undigested or semi-digested organic manures.

Among the decomposed manures, vermicompost is rich in all types of major and minor nutrients, vitamins, enzymes, antibiotics, growth promoters etc. (Mitra, 1997; Bhusan and Yadav, 2003). It is a form of organic manure, which can be produced from variety of organic wastes (cow dung, poultry waste, piggery waste, agricultural waste, etc.) by earthworms and is made up of worm castings (faecal excretion) and other organic material (Reinecke and Alberts, 1987). Sulochana et al. (2009) observed higher manurial value of the vermicompost as compared to raw cow dung and poultry droppings in terms of its effect on hydrobiology of water. Even if vermicompost dries up, there is no harm to its microflora hence, it is referred to as potential biological manure or biofertilizer (Meena, 2003). Vermicompost is found to be more nutritious than cow dung/farmyard manure in terms of more carbon and phosphorus, less potassium and comparable nitrogen (Shinde et al., 1992). Moreover, vermicompositing is a farmer friendly technique, where vermicompost can be prepared from variety of locally available plant and animal wastes without much cost, labour and exerpertise.

In view of the above discussion, the present study was conducted to study the effect of vermicompost on water quality, zooplankton production and growth of exotic carp, *Cyprinus carpio* (L.) in comparison to traditional manure used in aquaculture i.e. semi-digested cow dung.

2. Methods

An outdoor experiment was carried out in 20 m^2 (0.002 ha) cemented tanks for 120 days. Tanks were prepared a fortnight before stocking of fish. At the base of the tank, 5 cm thick soil bed was provided and filled with tubewell water. Manuring was done with

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semi-digested (8–10 days old) cow dung at a dose of 40 kg (20,000 kg/ha/year – CD_{20}) as control and vermicompost (prepared from cow dung) at a dose of 20 kg (10,000 kg/ha/year – VC_{10}), 30 kg (15,000 kg/ha/year – VC_{15}) and 40 kg (20,000 kg/ha/year – VC_{20}). Out of total amount, 25% of the doze was applied 15 days before stocking of fish and rest in equal weekly instalments after stocking of fish (Table 1). Twenty fingerlings of common carp, *C. carpio* (L.) were stocked (10,000/ha) per tank (0.002 ha). The average length and weight of fish was 14.73 cm (14.67–14.85 cm) and 49.94 g (48.4–51.2 g), respectively, at the time of stocking.

Traditional feed (deoiled rice bran – 44%, deoiled mustard cake – 44% and fish meal – 10%, mineral mixture – 1.5% and common salt – 0.5%) was used for feeding the fish @ 2% of its body weight daily. The proximate analysis of feed ingredients and of the diet was carried out by following the methods of AOAC (2000). Proximate composition (on dry matter basis) of the prepared diet was as – crude protein – 31.26%, crude fat – 4.78%, crude fiber – 12.80%, nitrogen free extract – 33.33%, ash – 14.97% and energy – 3.30 kcal/g. The feed was adjusted according to increase in the fish body weight observed after each monthly sampling. A constant water level was maintained in the experimental ponds by adding tubewell water to compensate the water losses due to evaporation and seepage. Water quality such as temperature, dissolved oxygen, pH, total alkalinity, soluble phosphate and ammonical nitrogen were measured at fortnightly intervals by following the standard methods of APHA (1991). Quantitative estimation of zooplankton was also done at fortnight intervals by using Sedgwick Rafter Cell. Growth of fish ($n = 10$) was assessed by measuring body length and weight at regular monthly intervals. Data was analyzed for following parameters:

$$\text{Weight gain (g)} = \text{Final body weight (g)} - \text{Initial body weight (g)}$$

$$\text{Percent weight gain (\%)} = \frac{\text{Final body weight (g)} - \text{Initial body weight (g)}}{\text{Initial body weight (g)}} \times 100$$

$$\text{Specific growth rate (\% wt gain/day)} = \frac{\ln \text{final body weight (g)} - \ln \text{initial body weight (g)}}{\text{culture period (days)}} \times 100$$

ln = Natural logrithum.

Data was analyzed using STATGRAPHICS statistical package. Differences among different treatments were calculated by using one way ANOVA ($P \leqslant 0.5$).

Table 1
Manuring schedule (per pond) in different treatments.

Treatments (manure)	Total dose (kg)	Initial dose (kg)	Weekly dose (kg)
CD_{20}	40	10	0.625
VC_{10}	20	5	0.312
VC_{15}	30	7.5	0.468
VC_{20}	40	10	0.625

3. Results

The study revealed that during the experimental period, water quality parameters such as temperature, dissolved oxygen, soluble phosphate and ammonical nitrogen did not vary significantly in various treatments, whereas, pH and total alkalinity differed significantly being maximum in VC_{20} and CD_{20}. The values of all these

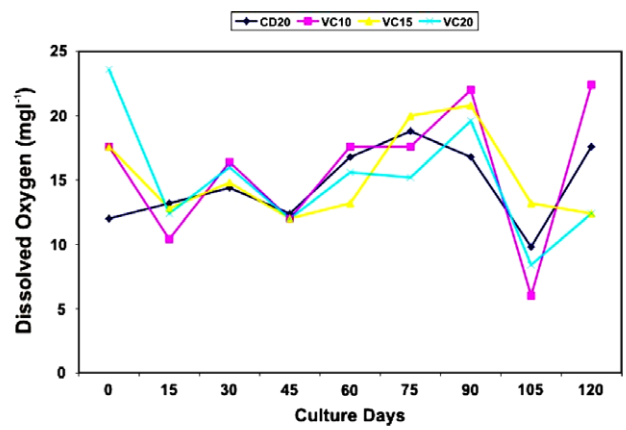

Fig. 1. Changes in dissolved oxygen (mg l^{-1}) in different treatments.

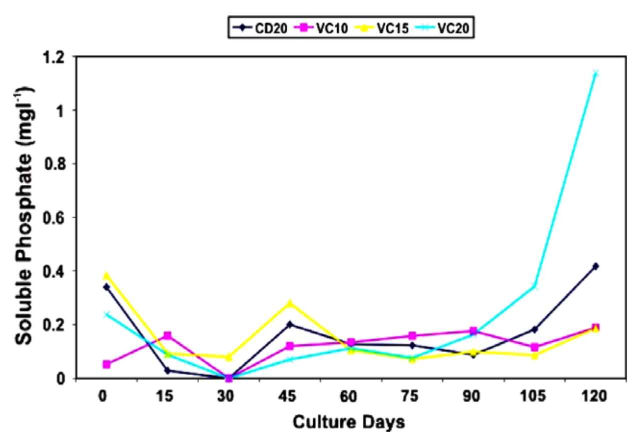

Fig. 2. Changes in soluble phosphate (mg l^{-1}) in different treatments.

Table 2
Hydro-biological parameters (average value ± S.E.) in different treatments during the culture period.

Parameters	Treatments			
	CD_{20}	VC_{10}	VC_{15}	VC_{20}
Temperature (°C)	16.49 ± 1.74^a (9.5–23.5)	16.52 ± 1.76^a (9.5–23.8)	16.46 ± 1.78^a (9.0–23.5)	16.47 ± 1.77^a (9.5–23.8)
D.O. (mg l^{-1})	14.64 ± 1.01^a (9.8–16.8)	15.78 ± 1.79^a (6.0–22.4)	15.20 ± 1.13^a (12.0–20.8)	15.02 ± 1.50^a (8.4–23.6)
pH	9.10 ± 0.07^a (8.6–9.4)	9.12 ± 0.15^a (8.5–10.0)	9.18 ± 0.08^a (8.9–9.7)	9.24 ± 0.77^a (9.1–9.7)
Total alkalinity (mg l^{-1})	239.11 ± 10.48^a (192–298)	212.67 ± 6.49^b (186–250)	215.78 ± 4.30^b (204–240)	232.00 ± 7.21^{ab} (192–264)
Soluble phosphate (mg PO_4–P l^{-1})	0.16 ± 0.04^a (0–0.41)	0.12 ± 0.02^a (0–0.19)	0.15 ± 0.04^a (0.07–0.38)	0.14 ± 0.03^a (0–0.34)
Ammonical nitrogen (mg NH_3–N l^{-1})	0.002 ± 0.002^a (0–0.02)	0.007 ± 0.007^a (0–0.06)	0.007 ± 0.005^a (0–0.05)	0.004 ± 0.003^a (0–0.03)
Zooplankton production (No. l^{-1})	558.96^a (185–1445)	567.86^a (80–1607)	581.47^a (124–1731)	549.19^a (138–1314)

Values with different superscripts in a row differ significantly ($P \leqslant 0.5$).
Values in Parenthesis are range of the parameter.