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# Influence of different organic manures on population and diversity of zooplankton in fish rearing cisterns

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**Abstract**
Indian aquaculture is rapidly expanding sector and has great demand. The productivity of aquaculture ponds is not stable. Fertilization is the cheapest and simplest means of increasing aquatic productivity though increased phyto and zooplankton population. In present investigation, different organic manures (Cow dung, poultry manure and cowdung+poultry manure) were evaluated for production of zooplankton which is most preferred food for fishes. Among the treatments, the average total zooplankton density over the period was the highest in PM treatment, followed by CD+PM treatment and CD treatments. The important zooplankton encountered in the various treatment during the experimental period belonged to the groups rotifer, Cladocera, copepod, Ostracoda, crustacean eggs and larval forms. The rotifer were found to be the most dominant group in all the treatment. The group next in abundance was Cladocera, followed by copepod and larval forms. The group Ostracoda were encountered to a lesser extent.

**Keywords:** Poultry manure, cowdung, zooplankton, organic manure

## Introduction
The development and expansion of aquaculture industry is linked with the availability of quality seed. A carp fishes being the main stay of Indian aquaculture, the technology of its seed production has long been perfected and is a practice in a large scale to cater the seed demand of the sector. India is a carp fish's dominant country because the wide tolerance of carps to adverse water quality conditions and has good market in the country. The country is not self-sufficient in meeting the desired quantum of seeds of all the principal fish species (Banerjee *et al*.,1979) [1].

The growth rate mainly depends upon the type of rearing system adapted and stocking density. Fertilization is the cheapest and simplest means of increasing aquatic productivity. Both organic and inorganic fertilizers are used in fish pond. The usefulness of different kinds of manures such as poultry dropping, dung of cow, sheep and goats is established in fish culture and they are the suitable substitutes for the costly feeds and inorganic fertilizers currently in use (David *et al*., 1969) [2].

Organic manures stimulate the growth of fish food organisms both phytoplankton and zooplankton. The conventional practice of use of organic manures is to apply a single large dose at the beginning of the culture period. Whenever refertilization is done, the time gap between two consecutive applications is often too long. The optimum time interval between referitlization is not known. Moreover, the application of large doses of organic manures results in deterioration of water quality. Also the nutrients can be retained in the water only for a short period as they are quickly lost from the water body (Hepher, 1967) [3]. The zooplankton is considered as one of the most important food for cultivated carps. The abundance of zooplankton depends not only on the density of phytoplankton but also on other ecological factors. Zooplankton density is a reliable index of the productivity of aquatic system. In present investigation, different organic manures (Cow dung, poultry manure and cowdung+poultry manure) were evaluated for production of zooplankton which is most preferred food for fishes.

## Materials and Methods
### Preparation of ponds
The ponds were prepared by cleaning them properly and added one inch thickness of red soil was added each pond., lime ($CaCO_3$) was applied at a dose of 0.170 g. per $m^2$ and then after 3 days, the ponds were fertilized properly by organic fertilizers using proper dose in the respective three treatment groups. After 7 days of fertilization, the ponds were stocked with

carp fry (Catla:Rohu:Common Carp) at a density of 30 No/$m^2$ in the ratio of 4:3:3 to the ponds of all the treatments and replications. From the second day of stocking, fry were fed twice daily with a mixture of finely powdered dried groundnut oil cake and rice bran at the ratio of 1:1. Initial zooplankton population was recorded from all the ponds and species of the zooplankton was identified. Further, every week zooplankton population was recorded from all the ponds and identification of species was done.

**Application of organic manures**

The experiment was under taken in cement ponds of the Zonal Agricultural and Horticultural Research Station Brahmavara, Udupi District, Karnataka. The size of ponds was equal having 8.57 $m^2$ each. The average depths of the ponds were 2.5ft. Three types of fertilizer, like cow- dung, poultry manure and cowdung + poultry manure **(**10,000 kg, 5000 kg and 5,000+ 5,000/ha were tried in treatments $T_1$, $T_2$ and $T_3$ respectively. Treatments with three replicates were applied.

**Sampling of zooplankton**

A conical plankton net (60m) mesh size and having a rectangular mouth with an area of 200 $cm^2$ (20x10 cm) was used to collect the plankton samples. The net was dragged just under the water surface along one side of the cistern, thus filtering about 100lit of water. The collected plankton samples were then preserved in 4% formalin solution (Sladeck *et al*., 1982) [4] and stored in labelled polythene containers for qualitative and quantitative analysis.

**Analysis of zooplankton**

**Direct census method of counting:** In this method, a Sedgwick rafter type plankton counting cell, made of transparent plastic, designed to hold 1 ml of sample and whose surface divided into 100 equal squares, was used. The plankton samples were diluted to about 50 to 60 ml and mixed thoroughly. From the above suspension, 1 ml of sample was taken and counted under 100 x magnifications, using a compound microscope. Whenever the collection of plankton was too concentrated, further dilution was made to facilitate easy counting. For zooplankton all the 100 squares were counted. After counting the number of plankton per litre of pond water was enumerated.

**Results and Discussion**

The addition of manure influences the relative abundance of plankton density and their community structure in pond aquaculture system. A direct relationship between average plankton density and fish production was recorded. The proper utilization of organic wastes by integrating with other farming system provides low cost fish production. Integrated fish-poultry farming system is also another best option for low-cost fish production. High density and diversity of plankton were found in the pond fertilized with poultry and cow manure than non-fertilized pond using poultry manure. However, indiscriminate use of this manure in fish ponds may deteriorate the water quality of the pond. Therefore, it is necessary to know the standard doses of the manures which would keep the physico-chemical parameters of pond water in favourable ranges for survival and growth of fishes.

In present investigation, after initial fertilization total zooplankton density increased conspicuously in all the treatments up to the 21st day, but thereafter decreased slightly in Cow -dung treatment upto the 42nd day (Table 1). Fallowing refertilization the zooplankton density was increased in PM treatment on the 28thday, Zooplankton numbers increased markedly in PM and CD+ PM treatments up to the 63rdday, whereas they declined slightly in CD treatment. with each subsequent dose of manure ,zooplankton increase noticeably in CD and CD+PM treatments in the following week. The difference in the density of zooplankton between treatments became more noticeable and prominent after the 28thday, when the density was more in PM treatment, followed by CD+PM and CD treatments in that order. The fluctuation in total zooplankton density was low in CD and CD+PM treatments and high in PM treatment. The average density of total zooplankton ranged from 10 to 145 no./l in CD treatments, 16 to 283 no./l in PM treatment, 13 to 190 no./l in CD+PM treatment (Table 3), during the period of study. The lowest value of zooplankton in the different treatments were observed on the first sampling day, prior to initial fertilization. The highest population of zooplankton was 283 No./l recorded in PM treatment on the 28th day (Table 2). The results are supported by Morsi (2014) and reported that, the application of rice straw extract as organic manure to produce sufficient quantity of phytoplankton and zooplankton for nursery fish pond management. Sulochana and Gaur (2010) [6] conducted the experiment on growth and survival of rohu fry to fingerlings using different organic manures like vermicompost, poultry manure, cow dung, among which vermicompost gives good result followed by poultry manure and cow dung may be due to least $H_2S$, free $CO_2$ and ammonical nitrogen released on decomposition and good amount of plankton production.

In present investigation, the mean total zooplankton density over the period was the highest in PM treatment, followed by CD+PM treatment and CD treatments, which two, however, were comparable (Table 1, 2 & 3). There was no correlation between dissolved organic matter concentration and total zooplankton number for the three treatment combined but PM and CD+PM treatment each taken individually exhibited a high positive association between the two parameters ($p<$ 0.01). The important zooplankton encountered in the various treatment during the experimental period belonged to the groups rotifer, Cladocera, copepod, Ostracoda, crustacean eggs and larval forms. The rotifer were found to be the most dominant group in all the treatment. The group next in abundance was Cladocera, followed by copepod and larval forms. The group Ostracoda were encountered to a lesser extent. Generally, the Rotifers, Copepods and Cladocerans were more abundant in CD treatment (Table 1).

The important genera which represented the rotifer were Branchionus ssp., Keratella ssp., Asplanchna ssp., Trichocera ssp., Polyarthera sp., Hexartha ssp., and Filinia ssp. Cladocera were broadly classified as “other Cladocerans”. Copepods were represented by Cyclops ssp. and diatomus ssp. and ostracods were grouped as such. Larval forms included the larvae of crustaceans and rotifers. Some small protozoa were also encountered occasionally (Table 1, 2 & 3). The results are in accordance with Kangombe *et al*. (2006) [7] and reported that, the production of zooplankton such as copepods, cladocerans (daphnia and moina) and rotifers (lecane and brachioni) was higher in ponds manured with poultry manure. Nandeesha *et al*. (1984) [8] observed that, cladocerans were especially abundant in poultry manure treated waters. The copepods (*Cyclops* spp., and *Diaptomus* spp.) numbers were greater in PM and CD+PM treatments. Earlier workers also have recorded that, copepods were produced in abundance in waters fertilized with poultry manure.

**Table 1:** Fluctuations of Zoo planktons (No. / L) treated with cow-dung

| Zooplanktons | Initial | 1st week | 2nd week | 3rd week | 4th week | 5th week | 6th week | 7th week | 8th week | 9th week |
|---|---|---|---|---|---|---|---|---|---|---|
| Brachionus sp. | 0.33 | 259.00 | 5.33 | 0.00 | 7.67 | 2.33 | 15.00 | 41.33 | 4.33 | 1.67 |
| Keratella sp. | 0.33 | 10.00 | 0.00 | 44.33 | 18.00 | 57.00 | 8.67 | 3.67 | 2.00 | 3.33 |
| Filinia sp. | 0.33 | 7.00 | 0.00 | 0.00 | 0.33 | 5.00 | 3.67 | 8.00 | 0.33 | 0.33 |
| Polyorthra sp. | 0.33 | 0.67 | 0.33 | 0.67 | 0.67 | 3.00 | 49.33 | 18.00 | 13.67 | 3.00 |
| Hexarthra sp. | 0.33 | 5.00 | 10.33 | 22.00 | 3.67 | 1.00 | 2.67 | 5.33 | 8.00 | 0.67 |
| Asplanchina sp. | 0.67 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 |
| Trichoceras sp. | 0.00 | 0.00 | 1.33 | 6.67 | 1.00 | 0.67 | 1.67 | 0.33 | 0.33 | 0.00 |
| Moina sp. | 0.00 | 25.67 | 5.67 | 5.33 | 0.00 | 0.00 | 0.33 | 1.00 | 0.00 | 0.33 |
| Cyclops sp. | 0.33 | 3.00 | 9.33 | 5.33 | 2.00 | 1.00 | 2.00 | 4.00 | 5.33 | 2.33 |
| Diaptomus sp. | 0.67 | 3.33 | 39.67 | 8.00 | 3.00 | 1.33 | 1.33 | 1.67 | 0.67 | 0.33 |
| Ostracods sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.67 | 0.00 | 0.00 | 0.33 | 0.00 |
| Larval stages | 0.33 | 16.67 | 59.33 | 24.33 | 7.67 | 28.00 | 13.33 | 37.00 | 10.33 | 9.00 |
| Other rotifers. | 1.33 | 6.67 | 0.33 | 1.00 | 0.67 | 1.33 | 1.33 | 2.33 | 1.33 | 0.33 |

**Table 2:** Fluctuations of Zoo planktons (No. / L) treated with poultry manure

| Zooplanktons | Initial | 1st week | 2nd week | 3rd week | 4th week | 5th week | 6th week | 7th week | 8th week | 9th week |
|---|---|---|---|---|---|---|---|---|---|---|
| Brachionus sp. | 1.33 | 27.33 | 0.33 | 3.00 | 15.67 | 14.67 | 10.33 | 44.00 | 41.33 | 24.67 |
| Keratella sp. | 0.00 | 4.00 | 2.00 | 1.00 | 67.67 | 133.00 | 8.67 | 1.33 | 0.00 | 29.33 |
| Filinia sp. | 0.00 | 0.00 | 0.00 | 0.33 | 9.00 | 0.00 | 0.00 | 98.00 | 0.33 | 0.67 |
| Polyorthra sp. | 0.67 | 0.33 | 0.33 | 0.00 | 0.33 | 0.00 | 0.67 | 5.67 | 3.33 | 22.33 |
| Hexarthra sp. | 1.00 | 8.33 | 7.67 | 5.33 | 27.67 | 17.67 | 1.67 | 35.00 | 0.67 | 3.00 |
| Asplanchina sp. | 1.33 | 1.67 | 0.00 | 0.00 | 1.33 | 1.00 | 3.33 | 1.00 | 0.00 | 0.00 |
| Trichoceras sp. | 0.67 | 0.00 | 0.00 | 0.00 | 4.67 | 2.00 | 15.00 | 7.00 | 2.33 | 2.00 |
| Moina sp. | 1.00 | 25.33 | 0.33 | 0.67 | 2.67 | 7.33 | 5.00 | 16.00 | 19.67 | 10.67 |
| Cyclops sp. | 0.33 | 0.33 | 1.00 | 0.33 | 0.67 | 1.33 | 1.00 | 2.33 | 24.67 | 19.00 |
| Diaptomus sp. | 4.67 | 4.33 | 11.33 | 15.33 | 2.67 | 10.67 | 0.33 | 0.00 | 1.00 | 1.00 |
| Ostracods sp. | 0.00 | 0.67 | 0.33 | 0.00 | 3.67 | 12.00 | 4.33 | 0.00 | 6.67 | 18.00 |
| Larval stages | 2.67 | 4.33 | 16.67 | 3.00 | 9.67 | 15.33 | 0.33 | 44.67 | 29.00 | 40.33 |
| Other rotifers. | 1.00 | 0.00 | 0.00 | 0.00 | 7.00 | 1.67 | 0.00 | 0.00 | 0.00 | 0.00 |

**Table 3:** Fluctuations of Zoo planktons (No. / L) treated with Cow dung + Poultry manure

| Zooplanktons | Initial | 1st week | 2nd week | 3rd week | 4th week | 5th week | 6th week | 7th week | 8th week | 9th week |
|---|---|---|---|---|---|---|---|---|---|---|
| Brachionus sp. | 1.00 | 143.33 | 3.00 | 1.33 | 11.67 | 9.00 | 12.33 | 42.33 | 22.33 | 13.00 |
| Keratella sp. | 0.00 | 7.00 | 1.67 | 22.33 | 42.67 | 76.33 | 8.33 | 2.33 | 0.67 | 2.67 |
| Filinia sp. | 0.33 | 3.33 | 0.00 | 0.33 | 4.67 | 2.33 | 2.00 | 52.67 | 0.00 | 0.33 |
| Polyorthra sp. | 0.67 | 0.33 | 0.33 | 0.33 | 0.67 | 1.33 | 24.67 | 11.67 | 7.33 | 12.33 |
| Hexarthra sp. | 0.67 | 8.00 | 8.67 | 13.33 | 15.67 | 9.00 | 2.00 | 20.00 | 4.00 | 1.67 |
| Asplanchina sp. | 1.00 | 1.00 | 0.00 | 0.00 | 0.67 | 0.67 | 1.33 | 0.33 | 0.00 | 0.00 |
| Trichoceras sp. | 0.33 | 0.00 | 0.67 | 3.33 | 2.67 | 1.00 | 7.67 | 3.67 | 1.33 | 1.00 |
| Moina sp. | 0.33 | 25.00 | 2.67 | 1.00 | 1.33 | 3.33 | 2.33 | 8.33 | 9.67 | 7.50 |
| Cyclops sp. | 0.00 | 1.67 | 5.33 | 2.67 | 1.33 | 1.00 | 1.33 | 3.00 | 14.67 | 10.67 |
| Diaptomus sp. | 2.33 | 3.67 | 16.67 | 11.67 | 3.00 | 5.67 | 0.67 | 0.67 | 0.33 | 0.33 |
| Ostracods sp. | 0.00 | 0.33 | 0.00 | 0.00 | 1.67 | 5.00 | 2.00 | 0.00 | 3.33 | 9.00 |
| Larval stages | 1.33 | 10.33 | 38.00 | 13.33 | 8.33 | 21.33 | 6.33 | 40.33 | 19.33 | 24.33 |
| Other rotifers. | 1.00 | 3.00 | 0.00 | 0.33 | 1.67 | 1.00 | 1.00 | 1.00 | 0.33 | 0.00 |

## Conclusion

Zooplankton density is a reliable index of the productivity of aquatic system. The average total zooplankton density over the period was the highest in PM treatment, followed by CD+PM treatment and CD treatments.The proper utilization of organic wastes by integrating with other farming system provides low cost fish production. Integrated fish-poultry farming system is also another best option for low-cost fish production.

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