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ARTICLE

EFFECT OF ORGANIC MANURE ON THE HYDRO-BIOLOGICAL CHARACTERISTICS OF FISH POND

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ABSTRACT

The availability of nutrients in the ponds, artificial feed and recycling of the nutrients regulates the fish productions. In the present investigations, different organic manure i.e vermicompost @ 15,000 kg/ha/yr, vermicompost @ 10,000 kg/ha/yr, cow dung @ 10,000 kg/ha/yr, poultry manure @ 6,000 kg/ha/yr, pig manure @ 4,000 kg/ha/yr used to monitored their effect on water quality parameters, bacterial population and growth performance of Catla catla, Labeo rohita and Cirrhinus mrigala. The maximum values of dissolved oxygen (5.81 to 8.65 mg/l), turbidity (35.96 to 16.30 cm), phytoplanktons (99 to 5,786 no/l) and zooplanktons (186 to 2,046 no/l) observed in pond waters treated with vermicompost @ 10,000 kg/ha/yr. While that of pH (5.63 to 5.80), alkalinity (200.00 to 360.62 mg/l), hardness (173.06 to 292.02 mg/l) found to be maximum in vermicompost @15,000 kg/ha/yr. Free CO2 (1.40 to 3.40 mg/l) and nitrogen (0.990 to 0.170 mg/l) found to be maximum in the pond waters treated with cow-dung @ 10,000 kg/ha/yr. Temperature (26.53 to 34 oC), potassium (3.24 to 23.94 mg/l) and phosphorous (0.72 to 0.199 mg/l) found to be maximum in the pond waters treated with poultry manure @ 4,000 kg/ha/yr. The range of water parameters increased significantly (P<0.05) in the pond waters treated with different manures. Pond fertilized with vermicompost @ 10,000, found to be best as compare to vermicompost @ 15,000, followed by cow dung @ 10.000, poultry manure @ 6,000 and pig manure @ 4,000 kg/ha/yr, respectively..

KEY WORDS
Vermicompost, bacteria, alkalinity, phytoplankton, manures, population

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INTRODUCTION

The over increasing demand for quality food especially the protein sources can be satisfied only through improved production of protein rich products. The aquaculture products could be one of the most import source of protein. Therefore, the improvement of aquaculture is only possible by increasing the integrated large network of man-made as well as natural reservoirs. The sustainable integrated management of such reservoirs could only increase the production of aquaculture products per unit area. The fish production mainly depends over the natural or inherits productivity of natural or manmade ponds. Various types of nutrients can be artificially provided to the fish ponds through addition of manures, fertilizers and supplementary feed. Nowadays, the natural productivity of the ponds are being enhanced through the artificial application of numerous types and dosages of natural or synthetic fertilizers and manures to meet the nutritional requirements, selection of high productivity fish species and their stocking ratios, alteration of the feeding ratio and frequency. Improving the production of beneficial phytoplankton, algae also boots the productivity of the fish as these microscopic phytoplankton sustain the primary productivity of an aquatic food chain [1]. Improvement in the various water quality parameters suitable for the fish growth, have been reported due to increased fertilization except the fluctuation of dissolved oxygen due to the application of high manuring rate [2]. The nitrogen, phosphorous and potassium released during the decomposition of organic manures in the water which serve as primary nutrients for the growth of all types of phytoplankton The improvement in the growth of decomposers such as bacteria and fungi have been found due to addition of organic fertilizers and such decomposers are critical to the removal of various types of toxic waste produced and accumulate due to the use of artificial fish feeds [3]. The maintenance of doses of organic manures in the fish ponds are also crucial as the decomposition of such material consumes all the dissolved oxygen thus water quality is deteriorated. Similarly, the use of organic manures and fertilizer in excess results depletion of dissolved oxygen which results in production of various types toxic gases such as H_2S, NH_3, CO_2, etc. Increase of such gases in the aquaculture ponds results higher growth of pathogenic microorganisms thus the aquaculture is reduced due to parasitic diseases [4]. The use of vermi compost is as organic fertilizer in agro-ecosystems as well as in aquaculture has also found improving the production. The quick availability of nutrients present in the vermin compost are 'ready- to-uptake forms which is a major advantage [5].

MATERIALS AND METHODS

A series of experiments carried out using earthen ponds with the size of 18ft × 20 ft from Sept., 2013 to Aug., 2014. The ponds cleaned with lime @ 200kg/ha/yr and filled with inland ground water obtained from deep tube wells and allowed to stabilize for about 15 days. The combination of different fish (C. catla as surface feeder, L. rohita as column feeder and C. mrigala as bottom feeder) species selected for experiments. The Indian major carp's fingerlings collected from Satroad fish farm situated at Hisar and stocked in tubs. Fingerlings acclimated in aquarium room for 10 days prior to the commencement of experiment. All fish fed daily twice @ 2% BWd^{-1} for the whole experimental duration of 12 months. Fish growth was monitored after regular 15 days interval in term of weight and length gain and feeding rate adjusted accordingly to APHA [6]. To fertilize the ponds with semi dried pig manure @ 4,000 kg/ha/yr (T2), poultry manure @ 6,000 kg/ha/yr (T3), cow-dung @10,000 kg/ha/yr (T4), vermicompost @10,000 kg/ha/yr (T5), vermicompost @15,000 kg/ha/yr (T6) and control (T1) applied at 25% initial and remaining

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split doses given at biweekly intervals in ponds. The various feed ingredients, used in the present study fish meal, processed soybean, rice bran, mustard oil cake and wheat flour. All the ingredients grounded and powdered prior to the preparation of experimental diets. The water quality parameters like dissolved oxygen, pH, alkalinity, turbidity, temperature, hardness, free CO2, potassium, nitrogen, phosphorus, phytoplankton and zooplanktons population were recorded at 15 days intervals according to method as describe by APHA [6]. The results compared using 'Completely Randomized Design' [7]. A 10 liters volume of pond water was filtered through a 125 µm mesh size plankton net and further concentrated to 40 ml in small plastic bottles. The filtrated planktons were immediately preserved and the plankton abundance were expressed as organisms per liter. A 1 ml volume of the concentrated plankton sample was transferred to the cell cavity of Sedgwich rafter cell and allowed to settle. Randomly 10 selected fields of chamber were counted under the microscope and the number of the planktons were calculated as follows:

Number of plankton/l = $(P \times C \times 100)/ L$
Where
P = the number of plankton counted from ten aquaria
C = Volume of final concentration of sample (ml)
L = the volume of water sample (l) filtered

RESULTS AND DISCUSSION

Camel The production of aquaculture products depends on the water quality which are one the most important factors responsible for the fish growth throughout the cultivation period. The high production of fish in only possible if the survival, growth, and reproduction of the fish will be high. Which depends on the water quality of the aquaculture ponds. The fish production will be reduced in the poor water. Indian major carp namely C. catla, L. rohita and C. mrigala stocked to evaluate the response of treated pond [8]. In the present study, a significant difference in dissolved oxygen observed between the treatments. The vermicompost @10,000 kg /ha/yr used in present study seemed to act as oxygen promoters as these caused significant increase in dissolved oxygen in pond water. The effect of vermicompost @ 10,000 kg/ha/yr was better than vermicompost @ 15,000 kg/ha/yr followed by cow-dung @ 10,000 kg/ha/yr, poultry manure @ 6,000 kg/ha/yr, and pig manure @ 4,000 kg/ha/yr, respectively. On the other hand, pond fertilized with vermicompost @ 15,000 kg/ha/yr showed dissolved oxygen increase up to 8.5 mg/l as compare 7.90 mg/l in the pond water in control treatment [Fig. 1]. Similar results were observed by Bansal [9] and Kaur [10]. They also reported significantly higher dissolved oxygen in vermicompost as compared to other organic manure (cow-dung). During the present investigation dissolved oxygen showed the negative and highly significant correlation with the water temperature in all the treatments.

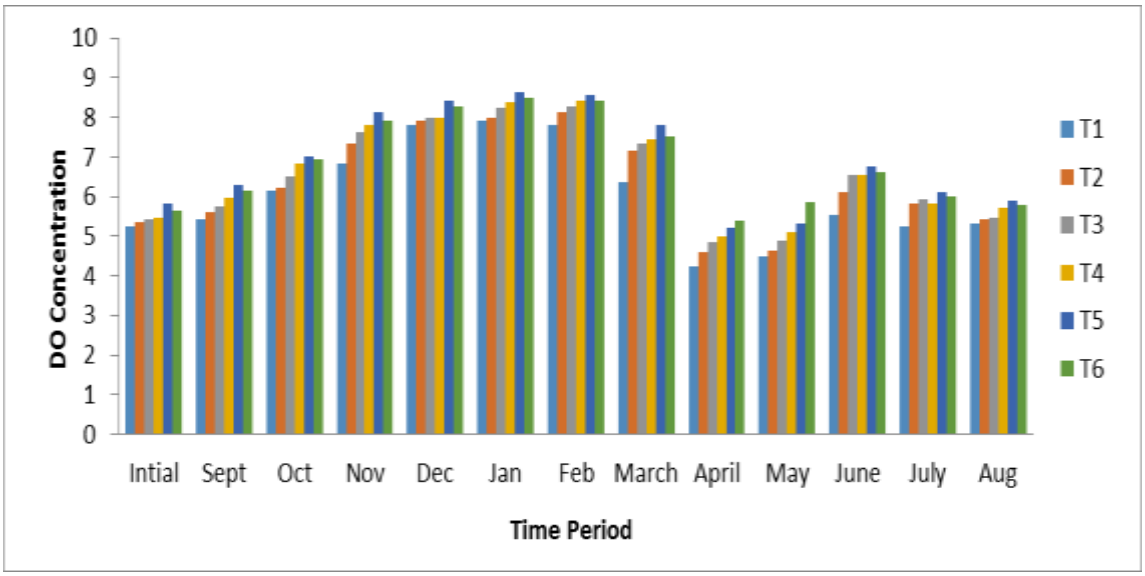

Fig. 1: Variation in dissolve oxygen (DO) during Sept. 2013 to Aug. 2014 in fish pond

The variation in pH level depending on a number of factor including species composition and plant communities. It can cause stress, increase susceptibility to disease, low production levels and poor growth [11]. The pH range between 5 and 10 in most of the natural waters [12] however, the pH is influenced by several factors such as discharge of wastewaters, acid rains, increase dissolution of atmospheric CO_2 and fish respiration. In the present study, a significant difference in pH observed between all the treatments and control. The pH found to be maximum in vermicompost @ 15,000 followed by vermicompost @10,000, cow-dung @ 10.000, poultry @ 6,000 and pig manure @ 4,000 kg/ha/yr, respectively [Fig. 2].

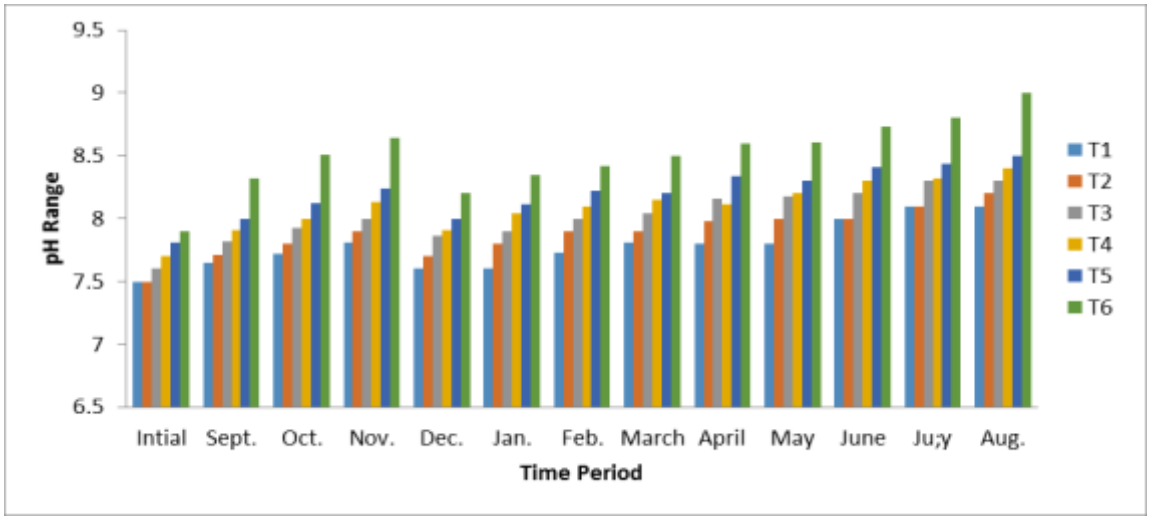

Fig. 2: Variation in pH during Sept. 2013 to Aug. 2014 in fish pond

On the other hand, pond fertilized with vermicompost @10,000 kg/ha/yr had pH 8.50. The pH was 8.10 in the ponds under control treatment. Throughout the experimental period, seasonal variation in pH was observed which varied from 7.5 to 9.0 in all the treatments due to respiration and photosynthetic activities. A positive and significant correlation among the pH and planktonic biomass was observed in all the treatments which are in accordance with the findings of Mahboob and Sheri [13]. The alkalinity of pond increased and reached up to 360.62 mg/l in the pond treated with vermicompost @ 15,000 kg/ha/yr. The alkalinity found to be maximum in treatment

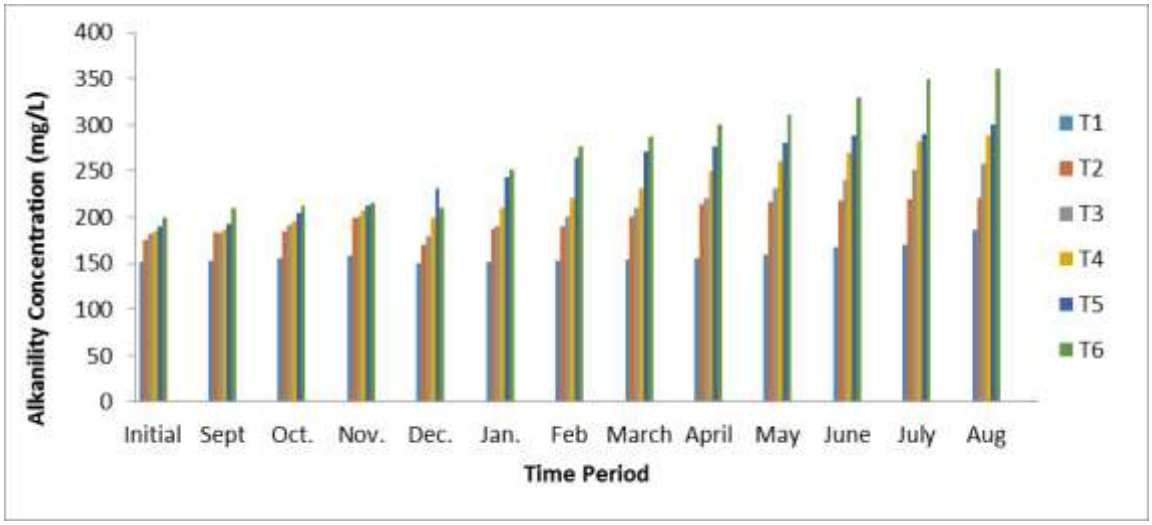

Fig. 3: Variation in water alkalinity during Sept. 2013 to Aug. 2014 in fish pond

vermicompost @ 15,000 kg/ha/yr followed vermicompost 10,000 kg/ha/yr, cow-dung @10,000 kg/ha/yr , poultry manure @ 6,000 kg/ha/yr and pig manure @ 4,000 kg/ha/yr [Fig. 3]. Similarly, pond fertilized with vermicompost @ 10,000, cow-dung @ 10,000, poultry @ 6,000 and pig manure @ 4,000 kg/ha/yr showed alkalinity increased up to 300.00, 288.41, 258.20, 220.80 mg/l as compared to 186.60 mg/l in the control fish pond.

Similar observations were reported by Kaur and Ansal [14]. Compared to other organic manure i.e. cow-dung, Kaur and Ansal [14] reported significantly higher alkalinity in vermicompost. Therefore, throughout the experimental periods the pond water was remained alkaline in all the treatments. Terziyski et al. [15] reported that the presence of carbonates and bicarbonates also make the pond water slightly alkaline which has been found to be favorable for the growth of the aquatic organism.

The hardness of pond increased and reached up to 292.02 mg/l in the ponds treated with vermicompost @ 15,000 kg/ha/yr. The hardness was found to be maximum in vermicompost @ 15000 followed by vermicompost @ 10000, cow-dung @ 10000, poultry manure @ 6000 and pig manure @ 4000 kg/ha/yr [Fig. 4]. The hardness was 178.20 mg/l in the ponds under control treatment.

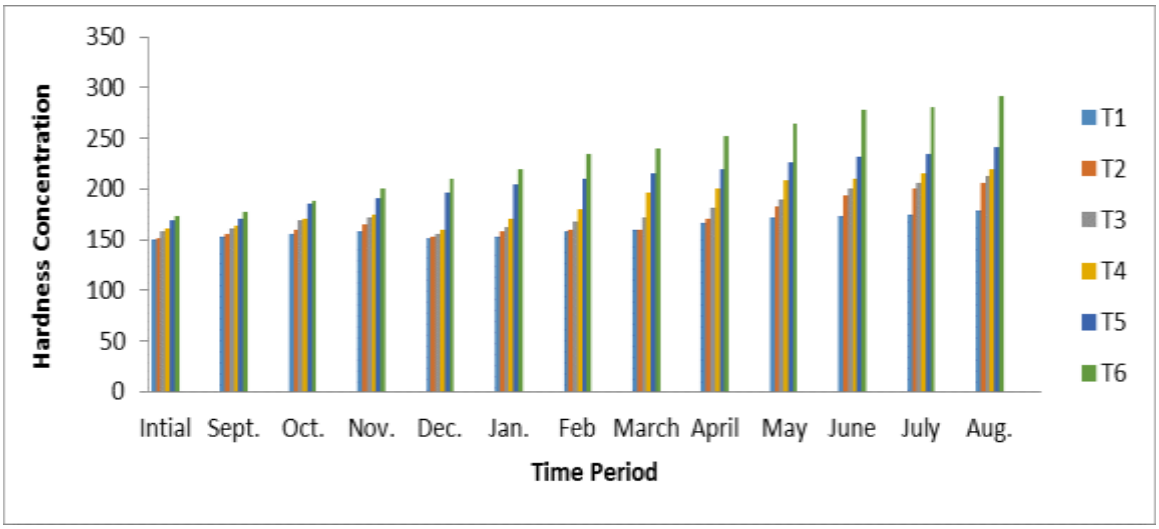

Fig. 4: Variation in hardness of water during Sept. 2013 to Aug. 2014 in fish pond

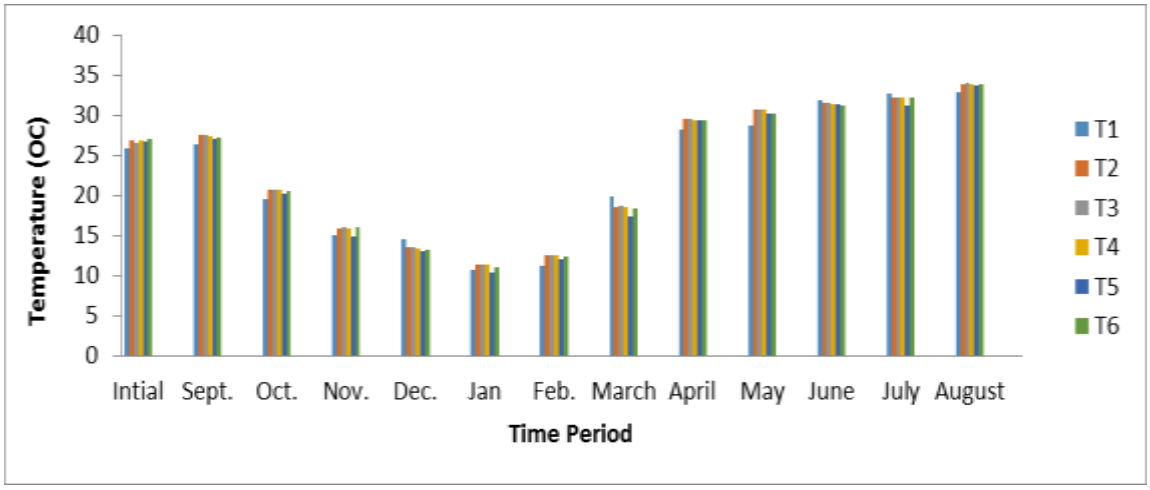

Fig. 5: Variation in Temperature of water during Sept. 2013 to Aug 2014 in fish pond

The temperature of the water temperature was comparatively 2-5°C lower than the air during the experimental durations. . In the present study, the water temperature ranged between 10.7-34.0°C [Fig. 5]. A significant difference observed in temperature between the vermicompost @15,000 kg/ha/yr, vermicompost @ 10,000 kg/ha/yr, cow-dung @ 10,000 kg/ha/yr, poultry manure @ 6,000 kg/ha/yr, pig manure @ 4,000 kg/ha/yr and control treated ponds in different proportions. The temperature of pond increased and reached up to 34 °C in the ponds treated with poultry manure @ 6,000 kg/ha/yr. The treatment poultry manure used in present study showed an enhancing effect as it caused significant increase in temperature of pond water due to decomposition of manure. The temperature was found to be maximum in poultry manure @ 6,000 kg/ha/yr followed by pig manure @ 4,000 kg/ha/yr, cow-dung @ 10,000 kg/ha/yr, vermicompost @ 15,000 kg/ha/yr and vermicompost @ 10,000 kg/ha/yr . The temperature was 32.82 °C in the ponds under control. Hayat et al. [16] reported a positive and significant correlation between planktonic biomass and the water temperature. The planktonic biomass and water temperature both are the important parameters which directly corresponds primary productivity of pond ecosystem thus responsible for the fish growth and yield. In the present investigation, the overall range of water turbidity was 35.96 to 11.20 cm. The turbidity of pond decreased and reached up to 14.30 cm in the ponds treated with cow-dung @10,000 kg/ha/yr. The turbidity was found to be maximum in vermicompost @ 10,000 kg/ha/yr followed by vermicompost @ 15,000 kg/ha/yr, cow-dung @ 10,000 kg/ha/yr, poultry manure @ 6,000 kg/ha/yr and pig manure @ 4,000 kg/ha/yr [Fig. 6]. On the other hand, pond fertilized with vermicompost @ 15,000 kg/ha/yr, cow-dung @ 10,000 kg/ha/yr, poultry manure @

6,000 kg/ha/yr and pig manure @ 4,000 kg/ha/yr showed decrease up to 15.00, 14.30, 13.00, 13.00 cm.

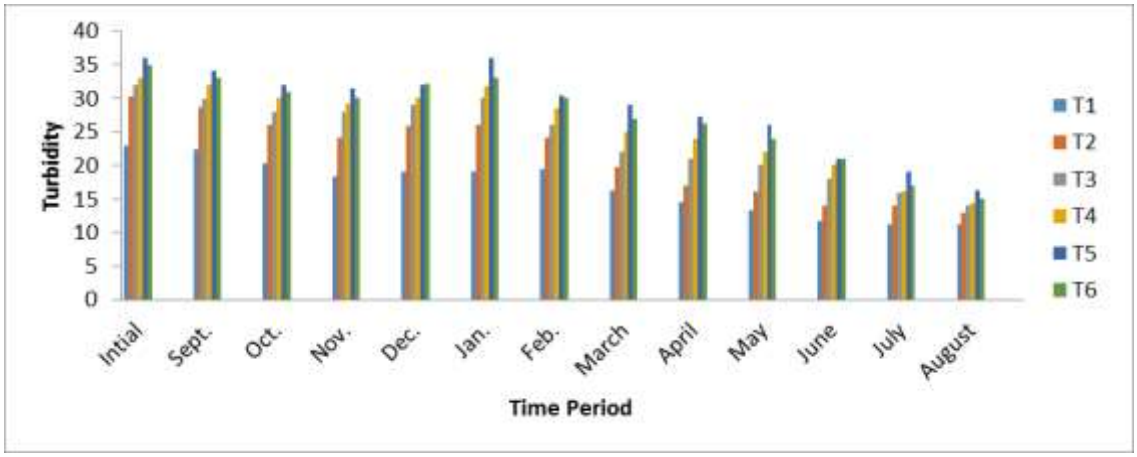

Fig. 6: Variation in water turbidity during Sept. 2013 to Aug. 2014 in fish pond

The mean values of turbidity in the pond water of control remained in a range of 22.90 to 11.20 cm. The primary productivity of water bodies depends on the light penetration therefore; it is also one of the limiting factors. The availability of light, essential nutrients and water temperature regulates various metabolic processes of aquatic organisms thus corresponds the overall biological productivity of a pond ecosystem which is a measure of planktonic [17 & 18].

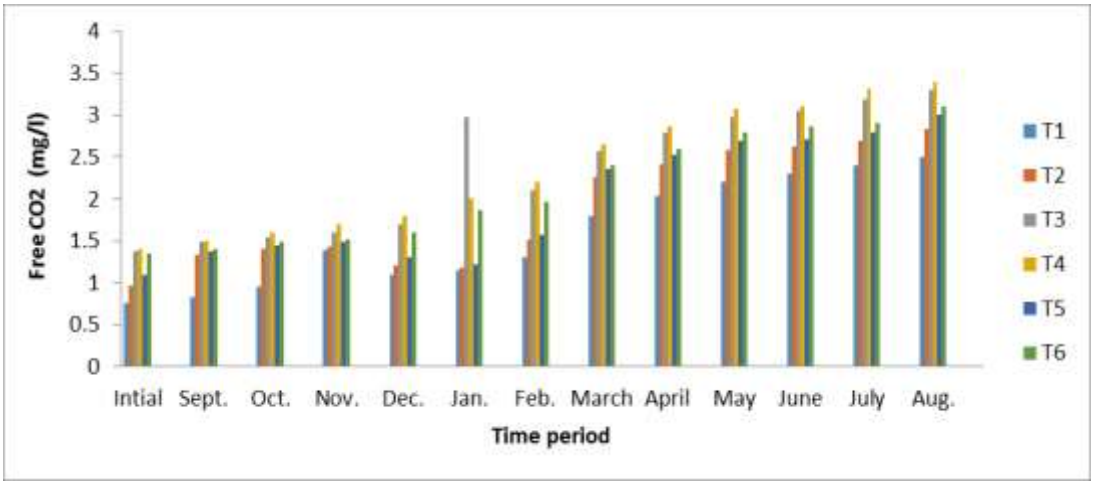

Fig. 7: Variation in free CO2 during Sept. 2013 to Aug, 2014 in fish pond

The treatment cow-dung used in present study showed an enhancing effect as it caused significant increase in free CO_2 of pond water. The free CO2 was found to be maximum in cow-dung @ 10,000 kg/ha/yr treatment followed by poultry @ 6,000 kg/ha/yr and vermicompost @ 15,000 kg/ha/yr, vermicompost @ 10,000 kg/ha/yr, pig manure @ 4,000 kg/ha/yr [Fig. 7]. On the other hand, pond fertilized with treatment poultry manure @ 6,000 kg/ha/yr, vermicompost @ 15,000 kg/ha/yr, vermicompost @ 10,000 kg/ha/yr and pig manure @ 4,000 kg/ha/yr showed increase up to 3.30, 3.10, 3.00, 2.84 mg/l. The free CO2 was 2.50 mg/l in the ponds under control treatment. Similar results were observed by Kaur [10] on free CO2 in vermicompost as compared to other organic manure (cow-dung).

The potassium of fish pond increased and reached up to 23.94 mg/l in the poultry manure@ 6,000 kg/ha/yr treated fishes. The poultry manure used in present study seemed to have potassium enhancing effect as it caused significant increase in potassium in fish pond. The effect of poultry manure @ 6,000 kg/ha/yr was better than pig manure @ 4,000 kg/ha/yr, cow-dung @ 10,000 kg/ha/yr, vermicompost @ 15,000 kg/ha/yr and vermicompost @ 10,000 kg/ha/yr [Fig. 8] . On the other hand, pond fertilized with pig manure @ 4,000 kg/ha/yr, cow-dung @ 10,000 kg/ha/yr, vermicompost @ 15,000 kg/ha/yr and vermicompost @ 10,000 kg/ha/yr showed increase up to 19.98, 18.36, 15.65, 14.27 mg/l values of potassium. The potassium was 7.78 mg/l in the ponds under control quantities exits in ponds is very complex because of the many states in which nitrogen can exist: NH3, NH4+, N2, N20, N0, N203, N205,

NO2-, and NO3-, nitrates are usually most important because living cells contain about 1-10% total nitrogen by dry weight. In the present study, a significant difference in NH4-N was observed between all six the treatments [Fig. 9]. The NH4-N of fish pond increased and reached up to 0.170 mg/l in the cow-dung @ 10,000 kg/ha/yr treated fishes. Over all, NH4-N also found to increase in Indian major carp fed on a diet containing cow-dung@10,000 kg/ha/yr. The effect of cow-dung @ 10,000 kg/ha/yr was better than vermicompost @ 15,000 kg/ha/yr, vermicompost @ 10,000 kg/ha/yr, poultry manure @ 6,000 kg/ha/yr and pig manure @ 4,000 kg/ha/yr. On the other hand, pond fertilized with vermicompost @ 15,000 kg/ha/yr, vermicompost @ 10,000 kg/ha/yr, poultry manure @ 6,000 kg/ha/yr and pig manure @ 4,000 kg/ha/yr showed increase up to 0.140, 0.135, 0.081, 0.070 mg/l value of NH4-N. The NH4-N was 0.050 mg/l in the ponds under control treatment [19, 20].

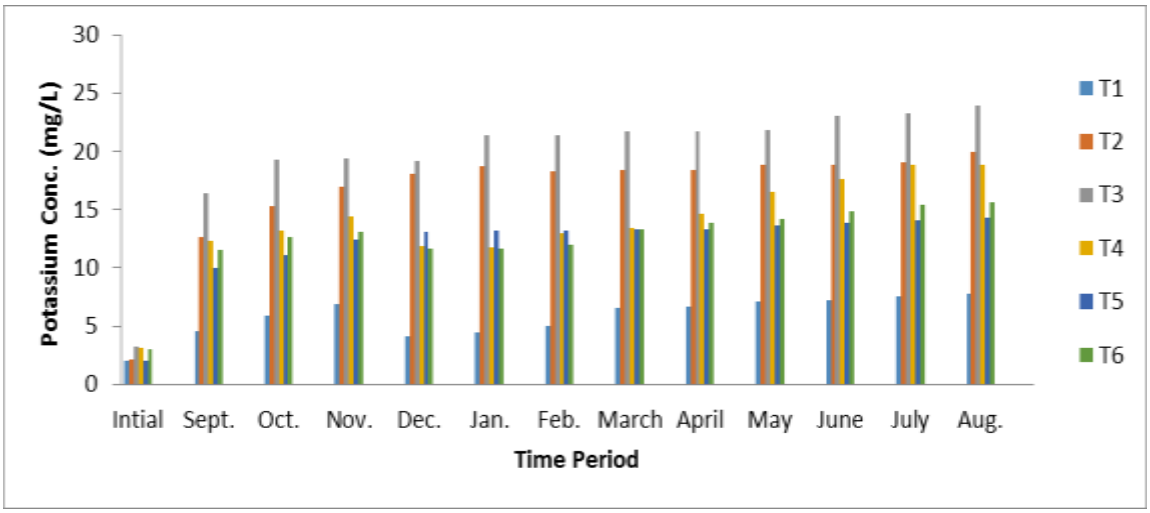

Fig. 8: Variation in water potassium concentration during Sept. 2013 to Aug. 2014 in fish pond

The amount of phosphorous of fish pond increased and reached up to 0.199 mg/l in the poultry manure @ 6,000 kg/ha/yr treated fishes. Over all, phosphorous was also found to increase in Indian major carp fed on diet containing poultry manure @ 6,000 kg/ha/yr. The treatment poultry manure used in present study seemed to have phosphorous enhancing effect as it caused significant increase in Indian major carp pond [Fig. 10]. The effect of poultry manure @ 6,000 kg/ha/yr was better than vermicompost @ 15,000 kg/ha/yr, vermicompost @ 10,000 kg/ha/yr, cow-dung @ 10,000 kg/ha/yr and pig manure @ 4,000 kg/ha/yr. On the other hand, pond fertilized with vermicompost @ 15,000 kg/ha/yr, vermicompost @ 10,000 kg/ha/yr, cow-dung @ 10,000 kg/ha/yr and pig manure @ 4,000 kg/ha/yr showed increase up to 0.186, 0.182, 0.175, 0.089 mg/l values of phosphorous. The phosphorous was 0.047 mg/l in the ponds under control treatment. A similar result was observed by Bansal [9] who found that vermicompost contained all the major nutrients compounds and high plankton occurred in ponds treated with organic manure mainly due to the content of phosphate.

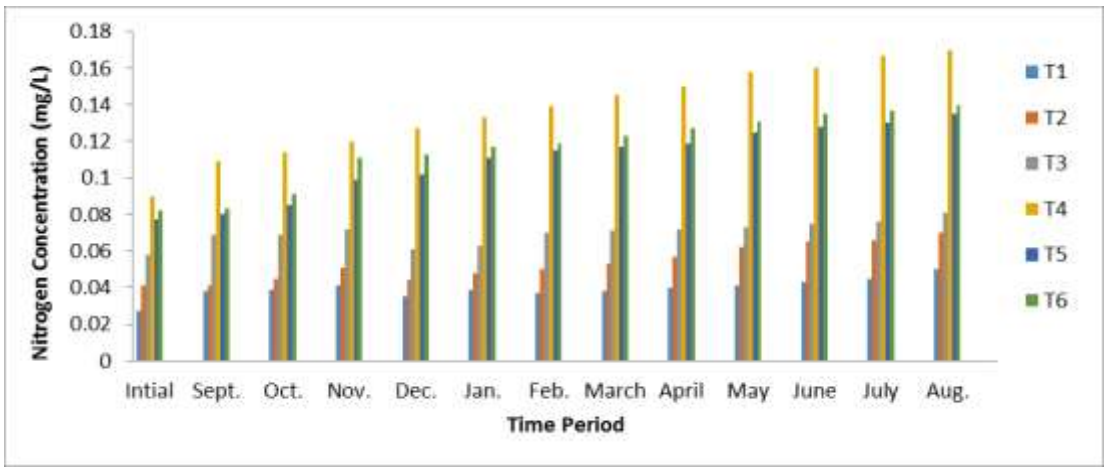

Fig. 9: Variation in water Nitrogen concentration during Sept. 2013 to Aug. 2014 in fish pond

The population density of zooplankton of fish pond increased and reached up to 2,046 no/l in the pond treated with vermicompost @ 10,000 kg/ha/yr [Fig. 11]. Vermicompost @ 10,000 kg/ha/yr used in present study seemed to have zooplankton enhancing effect as it caused significant increase in amount of nutrients in the pond. The effect of treatment vermicompost @ 10,000 kg/ha/yr was better than

vermicompost @ 15,000 kg/ha/yr, cow-dung @ 10,000 kg/ha/yr, poultry manure @ 6,000 kg/ha/yr and pig manure @ 4,000 kg/ha/yr. The zooplankton was 686 no/l found in the ponds under control treatment. The correlation between the total solids and planktonic biomass remained positive and significant in all the treatments noted.

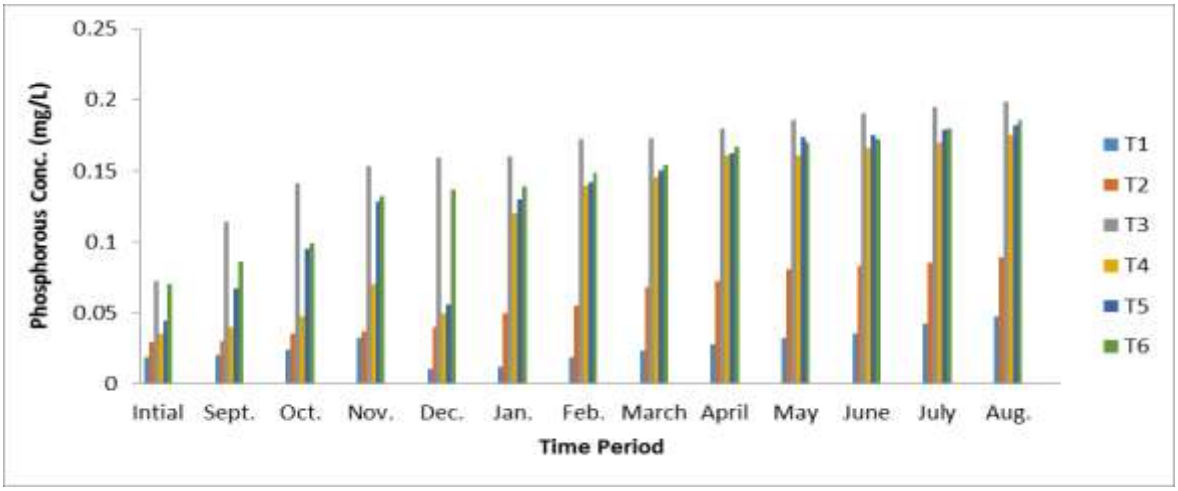

Fig. 10: Variation in water Phosphorus concentration during Sept. 2013 to Aug. 2014 in fish pond

The addition of fertilizers and natural manures in the aquaculture ponds provides basic nutrients and elements in ready to uptake form to the phytoplankton and zooplanktons which serve as a major source of food for fish [21]. The increased phytoplankton and zooplankton density can be correlated with the fish productivity. Chakrabarty et al. [4 & 22] also recorded significantly higher plankton production in vermicompost treated ponds as compare to traditionally use organic manure and inorganic fertilizers that ultimately enhances the fish growth. Cow-dung manure caused a marked increase in planktonic biomass in cow-dung @10,000 kg/ha/yr, which is an indication of well pond productivity. The population density of phytoplankton of fish pond increased and reached up to 5,786 no/l in the pond treated with vermicompost @ 10,000 kg/ha/yr [Fig. 12]. The vermicompost @ 10,000 kg/ha/yr used in present study seemed to have phytoplankton enhancing effect as it caused significant increase in amount of nutrients in the pond. The effect of treatment T5 was better than vermicompost @ 15,000, cow-dung @ 10,000, poultry manure @ 6,000, poultry manure @ 6,000 and pig manure @ 4,000kg/ha/yr. On the other hand, pond fertilized with vermicompost @ 15,000, cow-dung @ 10,000, poultry manure @ 6,000, poultry manure @ 6,000 and pig manure @ 4,000kg/ha/yr showed increase up to 4,839, 3,510, 2,988 and 1,122 no/l values of phytoplankton. The phytoplankton was 870no/l in the control treatment of pond water.

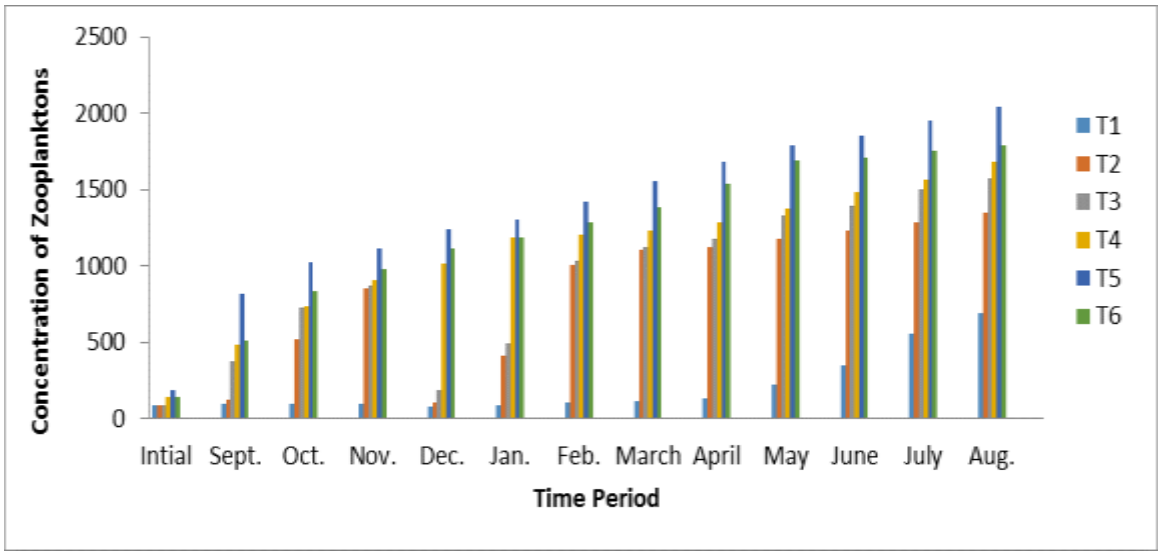

Fig. 11: Variation in Zooplanctons during Sept. 2013 to Aug. 2014 in fish pond

The correlation between the total solids and planktonic biomass remained positive and significant in all treatments noted.

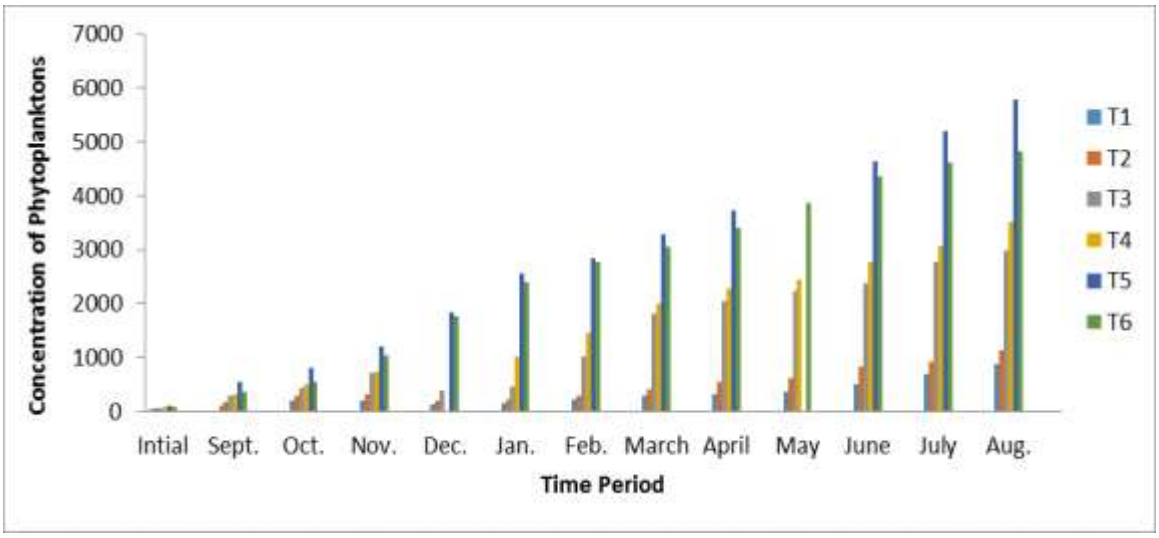

Fig. 12: Variation in Phytoplanktons during Sept. 2013 to Aug. 2014 in fish pond.

CONCLUSION

Fish can play a vital role in providing nutritional diet to the people especially in the present circumstances. This is especially true when one thinks about the growing population of the country and at the same time degraded varieties of the agriculture products due to over use of chemicals such as pesticides, fertilizers etc. looking to world's economy status, to increase the better fish production by using cheap and easily available resources like organic manure as pond fertilizers which enhance the algal bloom that ultimately increases the fish growth. Despite the known usefulness of vermicompost in aquaculture as organic manure for more production of carps, available information on the use of vermicompost in India, especially Haryana perspectives in rather scanty. All hydro-biological parameters were found to be in optimal range in vermicompost T5 as compared to others. The findings of the present study clearly demonstrated that water temperature played a major role towards fish growth among all the parameters. Comparatively higher increase in the fish body weight was observed during summer than the winter for all the treatments

CONFLICT OF INTEREST
There is to certify that there is no conflict of interests, technical or financial.

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FINANCIAL DISCLOSURE
None

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