Pakistan J. Zool., vol. 46(3), pp. 799-803, 2014.

Effect of Poultry Droppings on the Primary Productivity and Growth Performance of Major Carps in Polyculture System

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Abstract.- Effect of broiler droppings has been studied on primary productivity, and net fish yield of major carps for one year in four earthen fish ponds. *Catla catla, Labeo rohlita* and *Cirrhinus mrigala* were stocked with a ratio of 40:30:30 to test the input of broiler droppings. Based on its nitrogen contents (4.62%) broiler excreta was applied at a rate of 0.15 g nitrogen / 100 g of fish weight daily. The input of this nitrogen source significantly increased the fish weight, fork and total length. Statistically the differences were non-significant between *Labeo rohita* and *Cirrhinus mrigala* for an increase in their body weight. The plankton productivity, phyto- and zooplankton abundance and phytoplankton/ zooplankton ratios were significantly different in treated and control ponds. Increase in fish yield and nitrogen incorporation efficiency of fish was found to be correlated with water temperature and plankton productivity in treated and control ponds. The plankton biomass was found to depend on the water temperature. The net fish yield of 3951.42 and 828.64 kg/ha/year of major carps were secured from broiler manure treated and control ponds, respectively. The suitable environment in a manured pond resulted in a significantly better growth of major carps than the control pond. In the absence of any harmful effects of ammonia on the survival of fish, the fish yields can be quite easily enhanced with an application of broiler manure at low or no cost.

Key words: Major carps, polyculture, pond fertilization, phytoplanktons, animal manures.

INTRODUCTION

Fortunately, Pakistan is blessed with a vast expanse of freshwater fisheries resources which at present are not being adequately utilized due to lack of research and other technical inputs for the commercial fish farmer. Since it is more and more realized that capture fishery resources are not unlimited, emphasis has been given to enhance the production of fish from intensive farming in order to overcome the increasing gap between demand for and supply of fish. The availability of appropriate food, i.e. planktonic life and ecological parameters for fish in the pond, are the basic requirements for obtaining a high fish yield (Jha *et al*., 2004; Jasmine *et al*., 2011). The annual variations in water physical and chemical factors effect on the distribution and density of the plankton life in a pond (Mahboob, 2010; Enamul *et al*., 1999; Ahmad *et al*., 2011). In Pakistan, still limited research work is conducted on pond fertilization with organic and inorganic fertilizers (Sheri *et al*.,1986; Ahmad *et al*., 2013; Jasmine *et al*., 2011; Mahboob, 1992, 2014; Hassan and Javed, 1999; Abbas *et al*., 2008). It is important to mention that no extensive reports are available in the literature about polyculture of the indigenous carps in a local conditions to provide guidelines to the commercial farmers about the rate of application of various organic and inorganic manures, artificial feed and their production potential to meet the demand of animal protein in the country.

Fertilization of fish pond is the easiest and most economical method to secure higher yield by enriching the pond with the phytoplankton and zooplankton. It is one of the convenient intensification of the production of fish compared with artificial feeding. Fertilization enhances the growth of fish without any health risk. Its main objective is to enhance production of planktonic food for fish (Mahboob and Sheri, 1997). Enamul *et al*. (1999) reported the use of different fertilizers, particularly the use of phosphate to improve the production of phytoplankton. They also reported the planktivorous fish have the ability to digest different species of algae and concluded that it is more economical to enhance the production of algae through the application of inorganic fertilizers than organic manure.

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0030-9923/2014/0003-0799 $ 8.00/0

Economically viable aquaculture demands efficient utilization of nutrient inputs. Phytoplankton need nitrogen and phosphorus at a ratio of approximately 7:1 by weight (Round, 1973). In Pakistan, aquaculture has been traditionally mainly relied on polyculture of major carps including *Catla catla* Hamilton (1822), *Labeo rohita* Hamilton (1822) and *Cirrhinus mrigala* Hamilton (1822), and currently with other exotic carps such as *Hypophthalmichthys molitrix* Valenciennes (1844), *Ctenopharyngodon idella* Valenciennes (1844) and *Cyprinus Carpio* Linnaeus (1758) (Mahboob and Sheri, 1997). Animal manures often are applied in an intensive culture to boost fish production through an increasing planktonic growth through releasing nitrogen and phosphorus, or by providing an organic carbon through heterotrophic cycle. The fish may feed directly on the planktonic algae, detrital /fungal floes, or zooplankton and snails which feed on algae and detritus (Colman and Edwards, 1987). This necessitates the recycling of organic manures to enhance production of fish at low or no cost. Therefore, integrated fish farming can be termed as a model for recycling of wastes, maximum utilization of various farm products, saving energy and maintaining ecological balance. The present study was planned to study the effect of broiler droppings on pond primary productivity, growth and the annual yield of *Catla catla, Labeo rohita* and *Cirrhinus mrigala* with an application of broiler droppings in a polyculture system.

MATERIALS AND METHODS

Four newly dug earthen fish ponds of dimensions 15x8x2.5 m (length X width X depth) were used for this investigation. All the ponds were sun-dried and liming was done with CaO at the rate of 2.40 kg/pond (Mahboob, 1992) with the dusting method. All the ponds were filled with a un-chlorinated tube well water up to the level of 2.0 m and this level was maintained. A total of 82 four months old fingerlings of *Catla catla* (weight 2.87±0.08 g; fork length 53.23±0.05mm), *Labeo rohita* (weight 1.91±0.05 g; fork length 50.84±0.08 mm) and *Cirrhinus mrigala* (weight 1.68±0.02 g; fork length 51.68±0.06 mm) was stocked / pond with a stocking density of 2.87 m3/fish (Javed, 1988). The interspecies ratios *for Catla catla, Labeo rohita* and *Cirrhinus mrigala* were, 40:30:30, respectively. The percentage of N, P and K contents of broiler dropping was determined by following the methods described in AOAC (1984). Fertilization was done with sun-dried broiler manure (with 4.62±0.12% nitrogen; 1.66±0.14% phosphorus; 1.30±0.05% potassium) added based on their nitrogen contents at the rate of 0.15 g nitrogen / 100 g of fish weight/day for one year. However, the control pond remained without any additives.

Growth studies

The experimental fish was randomly sampled, with three repeats on every 16th day (designated as a fortnight) with the help of a nylon drag net from each of the ponds during the trial period. The fish body weight, fork length and total length were measured and recorded to monitor growth and released back into their respective ponds. The sample size for each fish species was 9 (Mahboob, 1992)

Statistical analysis

The data was statistically analyzed by using Minitab software. The differences among treatments were worked out using two way ANOVA. The differences were tested by the DMR test.

Table I.- Initial morphometric characteristics of *Catla catla, Labeo rohita* and *Cirrhinus mrigala* in control and treated pond.

Fish species	Average weight (g)	Average fork length (mm)	Average total length (mm)
Catla catla	2.97±0.10	53.23±0.05	59.31±0.09
Labeo rohita	1.94±0.07	50.84±0.08	57.62±0.07
C. mrigala	1.72±0.04	51.68±0.06	61.22±0.06

RESULTS AND DISCUSSION

The initial average body weights of *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* were 2.97±0.10, 1.94±0.07 and 1.72 ± 0.04, respectively (Table I). The final average weights of *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* in the treated and control ponds were recorded as 1339.66±3.14, 822.64±3.81 and 558.25±3.34 and 162.19±1.72,

Table II.- Final average weights (g), fork lengths (mm) and total lengths (mm) of *Catla catla, Labeo rohita* and *Cirrhinus mrigala* in control and treated ponds.

Fish species	Weight (g)		Fork length (mm)		Total length (mm)	
	Treated	Control	Treated	Control	Treated	Control
Catla catla	1339.66±3.14	162.19±1.92	396.55±1.07	200.27±1.13	457.25±0.67	241.82±0.74
Labeo rohita	822.64±3.81	160.08±2.01	345.35±1.09	199.50±1.26	396.85±1.47	235.27±1.59
Cirrhinus mrigala	558.25±3.34	156.84±1.66	343.25±1.33	208.32±1.08	386.37±2.26	238.09±2.18

Values are the means. ± S.E of three replicates

160.08±2.01 and 156.84±1.66g, respectively (Table II). A steady increase in weight was observed from the beginning of the experiment till the end of the study. Data on fork lengths and total lengths and net fish yields, from treated and control ponds are presented in Table II. The input of broiler droppings tremendously increased the growth of all the three fish species. The interactions (treatment x species) for morphometric characteristics were also highly significant. The increase in the growth of the fish after the application of manure has been reported by Hassan and Javed (1999) and Mahboob (1992). Jha *et al*. (2004) reported cow-dung efficiently enhanced the production of plankton. In this investigation the maximum weight was gained by *Catla catla* compared to *Labeo rohita* and *Cirrhinus mrigala* in control and treated pond (Table II). The fork and total length increase in *Catla catla* was also significantly better than other two fish species, thereby indicating that this species of fish responded better to broiler manure than the other two species. Javed *et al*. (1989) reported better growth performance after an application of cow-dung which is contradictory to the present results. This could be due to the difference in nitrogen content of the two organic manures. The broiler manure used in the present experiment had an average nitrogen content of 4.62 percent. The higher growth of three fish species in a treated pond was probably the result of higher primary productivity (91.42 g/m^3) compared to controls (Table III). The higher growth of fish may be due to better utilization of phytoplankton and zooplankton life which were with the mean annual densities of 72.44 and 44.54 individuals per 5 ml of water, respectively, in the broiler manure treated pond. The conversion efficiency associated with the existing planktonic biota is shown in Table IV. These findings suggest that organic manure promoted the synthesis of phytoplankton biota in particular, which stimulated the growth increment of these fish species in optimum water temperature (24.85 to 31.16°C). These findings support earlier investigations (Green *et al*., 1989; Knud-Hansena *et al*., 1991; Shailender *et al*., 2013) which concluded that organic manures can increase fish production by providing inorganic phosphorus, nitrogen and carbon (through respiration) for phytoplankton

Table III.- Treatment values for increase in fish yield, planktonic biomass conversion efficiency, plankton productivity and net fish yield.

	Control	Treated
Increase in fish yield (g/m^3)	3.64b	9.22a
Planktonic biomass (g/m^3)	16.66b	91.42a
Biomass conversion efficiency (%)	27.71a	16.22b
Phytoplanktonic Ind./5ml water	17.71b	72.44a
Zooplankton Ind./5ml Water	11.18b	44.54a
Phytoplankton/Zooplankton ratio	2.38a	1.82b
Net yields kg ha^{-1}	828.64b	3951.42a

Table IV.- Correlation coefficients among different parameters under study

Variable	Treated pond		Control pond	
	Water temp.	Planktonic biomass	Water temp.	Planktonic biomass
Increase in fish yield	0.941	0.813	0.687	0.598
Dry weight of planktonic biomass	0.865		0.364	
Nitrogen incorporation efficiency (NIE)	0.922	0.451	0.487	0.575

Critical value (J-tail, 0.05) = + or -0.334

growth, and organic carbon in detritus production and heterotrophic utilization (Ahmad *et al*., 2013). The maximum nitrogen incorporation efficiency of fish with this treatment was recorded during the 1st fortnight as 0.035 when the total fish weight of 1536.85 g was gained by using 54.75 g nitrogen in the form of broiler manure fertilizer, while the minimum NIE ratio (2.2537) was recorded during the 24th fortnight. The overall NIE, with the influence of broiler droppings was worked out as 0.3060. The results of this study substantiate the earlier reports for nitrogen level of significance incorporation efficiency of fish (NIE), being the variable, determined the growth rate of fish at an annual average water temperature of 21.94°C as reported by Nayak and MandaI (1990). A quantity of 1160.89 kg sun-dried cow-dung was added (which contained 1718 g nitrogen) to get 140.13 kg of fish with an overall NIE of 12.26%. Our results were in line with the findings of Shailender *et al*. (2013). They reported the overall maximum value of nitrogen incorporation efficiency (NIE) in organic manure treated pond as 1:5. Javed *et al*. (1990) reported 12.20% incorporation of nitrogen from the cow-dung into fish. An increase in fish yield, plankton biomass, phytoplankton and zooplankton densities were significantly better in the treated pond compared with the control pond (Table III). In treated and control ponds the increase in fish production was positive and significantly correlated with water temperature and existing dry weight of plankton biomass. The planktonic biomass were also found positively correlated with water temperature (Table IV). This exhibit the dependence of fish yield on plankton productivity, and both planktonic productivity and fish yield, in turn, were dependent on water temperature (Mahboob, 1992). Incorporation of nitrogen from broiler manure into the fish was found correlated with water temperature and plankton biomass in both the ponds. The present results confirm that this organic manure may serve as a direct source of food for the fish food organisms, or they may get decomposed for the release of inorganic nutrients (Boyd, 1981) that stimulated planktonic growth as evident from the relative abundance of zooplankton (44.54 g/m^3 of water) with a pond treated with a broiler droppings (Table III).

At the end of 12 months trial period, the ponds were harvested for a final net fish yield. Net fish yields of all the three fish species, together from treated and control ponds were 781.72 and 131.64 kg/pond, respectively. These results could be compared with the findings of Shailender *et al*. (2013).

CONCLUSIONS

It has been concluded that broiler droppings can be used as a source to enhance planktonic productivity in fish ponds safely. In the absence of any harmful effects of ammonia on survival the fish yields can be quite easily enhanced with an application of the broiler manure at low or no cost. The higher rate of application of organic manures may deteriorate water quality, reduce the plankton density and may have an adverse effect on the growth of the major carps. Further research on an application of organic manures and management of these fish species needs to be carried out in the future.

ACKNOWLEDGEMENTS

The authors would like to extend their sincere appreciation to the Deanship of Scientific Research at King Saud University for its funding of this research through the Research Group Project No.RGP-VPP-341.

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(Received 24 February 2014, revised 7 March 2014)