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COMPETITIVE ANALYSIS OF ADEQUATE FITNESS OF NITROGEN IN FISH PONDS TREATED WITH ORGANIC AND INORGANIC FERTILIZERS

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ABSTRACT

An investigation of adequate fitness of nitrogen (AFN) of fertilizers in fish pond was carried out by stocking Indian major carps (*Catla catla* and *Labeo rohita*) and common carp (*Cyprinus carpio*). After routine preliminary preparations, ponds were fertilized with two organic fertilizers (Cowdung and Poultry manure) and two inorganic fertilizers (Nitrophos and Urea). The inputs of fertilizers were done on monthly basis at the rates of 0.17 g N/100 g of fish of Poultry manure, 0.2 g N/100 g of fish of Cowdung, 0.15 gm N/100 g of fish of Nitrophos and 0.2 gm N/100 gm of fish of Urea and monitored their effects at four months interval. AFN values revealed that nitrogen released from the tested fertilizers have significant effects over in fish biomass. Among the used treatments organic fertilizers have been proven to the best and produced total fish biomass as much as 128.50 kg in Poultry manured fish pond and 73.14 kg in Cowdung treated ponds with the average AFN values of 0.99 and 0.96%, respectively. However inorganic fertilizers showed more than 1% of AFN and did not produced considerable quantity of fish biomass i.e. 42.89 kg in case of Nitrophose and 27.60 kg in case of Urea. The four monthly increase of fish biomass (IFB) also indicated the same results at the end of a year. 13.29 kg and 10.49 kg IFB were obtained in organically fertilized ponds. The quantity of nitrogen released from treatments has significant effects on synthesis of fish biomass. The relative growth rates (RGR) of stocked fishes exhibited the suitability of organic fertilizers. It is concluded that composition of organic fertilizers, nutrients releasing ability and algal production were ideally incorporated to produce fish biomass and have a clear advantage over the economics of carps aquaculture because of high cost of inorganic fertilizers without producing enough fish biomass.

KEYWORDS: Organic and inorganic fertilizer, Semi intensive, Fish biomass, Carps polyculture.

INTRODUCTION

In pond aquaculture primary producers (phytoplankton and some other microscopic organism) play a vital role and increase fish production. It is imperative to pay attention towards their growth and their relations to ecological factors. Lin (1970) suggested that water quality, Color and amount of green pigment (chlorophyll) reflect the good sustainable output of the Chinese carps-as the pursuit sustainable development of pond aquaculture system. It is ultimate to adopt the utilization of the most nutrient efficient, cost effective and eco-friendly input strategies that maximize both fish yield and personal income. Conventionally, this type of research has been a trial and error study evaluated by yield comparisons rather than focusing on another dynamic process which really determines the effectiveness of a particular fertilizer strategy (Anderson, 1993). The organic material and fertilizers serve as algal materials and stimulate production of both phytoplankton and zooplankton. The zoo serves as the one food source for secondary consumers (Boston *et al.,* 1989). The organic fertilizers which have been checked for their effectiveness regarding to enrich water for producing useful food items for fish are cow dung, poultry manure, swine manure and human wastes (Moll, 1986). However, Pant *et al.* (2002) applied urea and triple super phosphate to improve the water quality. They noted that substantial increase of fish yield followed by colour change of water from clear turbid to rich green. The average fish yield was three times more than previous yield obtained with traditional input.

Catla catla, Labeo rohita and *Cirhinus mrigala* are the most successful species of polyculture in Pakistan due to suitable climate for their culture. Nevertheless, the density of major carps in natural water has alarmingly declined. *Cyprinus carpio* is introduced instead of *C. mrigala* as bottom feeder fish as suggested by Wahab *et al.* (2002) and Milstein *et al.* (2002). *Cyrinus carpio* produce strongest disruption of mud bottom. This disruption cause nutrient release into water for photosynthesis. The *C. carpio* as bottom feeder fish could not be only as a target cultured fish but also as management tool. Farmers can get double benefits by introducing *Cyprinus carpio* and reduce input costs.

The present study was aimed to encourage the growth of major and common carp in a polyculture unit along with the nutrient released specially nitrogen. For this purpose cow dung, poultry manure, Nitrphose and urea have been selected. More over quality of bio nitrogen, its adequate fitness (AFN) and increase fish biomass are also highlighted.

MATERIALS AND MATERIALS

Experimental design: A series of experiments with three replications for each treatments were carried out using earthen ponds with the dimension of 15 x 8 x 1.5 m (length x width x depth).The combination of different carps (*Catla catla* as surface feeder, *Labeo rohita* as column feeder and *Cyprinus carpio* as bottom feeder fishes) were selected. Three months old, neonates of *Catla catla*, *Labeo rohita* and *Cyprinus carpio* were procured from fresh water fish hatchery operated by the Directorate of Fisheries, Government of Sindh, Chilya (Thatta District) Pakistan. The experimental neonates were obtained by means of induced breeding technique. The ponds were stocked with stocking density of 16:38:10 (*Catla catla*: *Labeo rohita*: *Cyprinus carpio*) as described by Sheri *et al*. (1986). The details of growth variables have been published earlier (Shoaib *et al.,* 2011).

Pond preparation: All the experimental ponds were prepared and sun dried. Soil samples were taken from different places and mixed homogeneously in order to estimate the nitrogen, potassium, and phosphorous contents along with pH. Powdered lime was applied to avoid infection at the rate of 9.60 Kg/pond, which was equivalent to 200 kg/ha as described by Hora and Pillay (1962). The inlets and outlets of all ponds were sealed with gauze of fine mesh for deprived of any predatory intruder into pond or exit experimental fish from the ponds. The ponds were initially filled with water up to the level of 1.5 m and this level was maintained throughout the experimental period. The amount of fertilizers used to enriched ponds was calculated on the basis of nitrogen availability. Poultry manure at the rate of 0.17 g N/100 g, Cow dung at the rate of 0.2 g N/100 g, Nitrophose at the rate of 0.15 g N/100 g and Urea at the rate of 0.2 g N/100 g were introduced daily. The proximate analysis was carried out for all fertilizers following the growth observation of AOAC (1990).

Competitive analysis of fertilizers: Nitrogen released by the fertilizers is a criterion to decide their suitability to promote algal growth. Adequate fitness of nitrogen (AFN) is a ratio of nitrogen augmented in fertilizers and fish biomass produced (Mehboob *et al.,* 1995) which was determined by the formula:

$$\text{AFN} = \text{Nitrogen augmented (g)} / \text{Increased body weight (g)}$$

The percentage of nitrogen contents in fertilizers was obtained by following the method described by AOAC (1992).

Statistical analysis: The obtained data were subjected to statistical analysis by using MINITAB Release 14. Regression analyses were performed to find out relationships among growth variables and ecological competitive parameters. Relative growth rates (RGRs) were calculated as:

$$\text{RGR} = \log e\ W_2 - \log e\ W_1 / t_2 - t_1$$

where W is the weight of fish and t is the time. The subscript 1 and 2 refer to the first and second consecutive harvests. Hunt (1982).

RESULTS

Cow dung treated pond: At the start of experiment all the introduced fish comprised of total fish biomass. Table 1 show increased fish biomass for each period, amount of cow dung introduced, proximate nitrogen contents and adequate fitness of nitrogen. During first period (Sep. to Dec.) 11.303 Kg of cow dung dropped which contain 0.015 Kg of proximate nitrogen and was responsible to increase 3.19 Kg of fish biomass with the 0.47% of adequate fitness ratio. As the water temperature gradually made its effects on pond ecology and regulate nutrient released from cow dung it was noted that almost biomass increased four times for 2nd and 3rd periods (Jan. to April and May to Aug.). The AFN values varied accordingly i.e. 0.30 and 0.40%, respectively. Regarding the subsequent increase in fish biomass it was noted that during first period of experiment (Sep. – Dec.) only 8.14% fish biomass was synthesized which was maximized four times in forthcoming four monthly observations (37.11% for Jan. – April and 54.74% for May – Aug.). Relative growth rates progressively increased with the maximum of 1.075 during second period.

Poultry manure pond: Poultry manure (11.67 Kg) was added in ponds. 0.014 Kg of proximate nitrogen was released to stimulate planktonic biomass. The produced planktonic biomass utilized nitrogen with the adequate fitness of 0.33 % in first period of study period (Sep. to Dec.). It was noticed that 2159.65 gm of fish biomass produced which was creped up to 6.29 Kg in 2nd period (Jan. to April) probably due to lowering of water temperature. When taking an over look on pattern of increase of fish biomass on four-month basis it is well elaborated that last period of experimental duration reclaimed is the best period of doubling fish biomass followed by 2nd and first period. The reason of this outcome was definitely an increasing trend of water temperature in all treatments. The subsequent increase in fish biomass was noted as much as 16.61% during first period of experiment (Sep.–Dec.) and creped up to 25.31% in second quarter (Jan. – April). In contrast to these substantially increased biomass was produced in the last period i.e. May – Aug. (58.31 %). Relative growth rates were progressively increased with the maximum 0.683 during third period.

Nitrophose treated pond: Nitrophose (1.348 Kg) was supplied to enrich fish pond. 0.01 Kg of proximate nitrogen was extracted and utilized to develop algal biomass. As a response of algal blooming 11.12 Kg of fish biomass was produced representing 0.55% of adequate fitness ratio of released nitrogen for the duration of first quarter. Impact of sunlight gradually triggers the pond´s ecology during subsequent quarters. it was well elaborately noticed that 2.549 Kg and 5.21 Kg of Nitrphose when dropped into ponds 0.027 Kg and 0.043 Kg of proximate nitrogen were released respectively i.e.;

Jan.-April and May-Aug. Increased fish biomass were also improved accordingly (6.14 Kg and 9.93 Kg) with 0.43% of adequate fitness ratio of nitrogen. The subsequent increase in fish biomass was noted as minimum as 10.12% during first four month of the experiment (Sep. – Dec.) and climbed up five times more (55.53%) in second period (Jan. – April) and in the last period i.e. May – Aug. (53.53%). Relative growth rates were progressively increased with the maximum of 0.638 during second period.

Urea treated pond: Urea (0.85 Kg) was added to augment in fish ponds. 0.012 Kg of proximate nitrogen was released to stimulate planktonic biomass. In response of blooming 1.968 Kg of fish biomass was produced by showing 0.60% AFN of released N for first four month of the experiment (Sep.-Dec.). Day light duration gradually extends and affects the ecological conditions during forth coming quarters. From Jan. to April and May to Aug. 1.59 Kg and 2.62 Kg of urea when dropped into respective ponds 0.024 Kg and 0.039 Kg of proximate N were released. There were 5.64 Kg and 7.79 Kg of IFB produced with the AFN ratios of 0.42 and 0.50%. The rates of producing IFB during the three period of experiment were calculated as 12.78, 36.64 and 50.61%, respectively. Relative growth rates were progressively increased with the maximum of 0.626 during second period.

Table 1. Adequate fitness of nitrogen and increased fish biomass of major carp (*Catla catla* and *Labeo rohita*) and common carp (*Cyrinus carpio*) in fish pond, treated with organic and inorganic fertilizers.

*Four monthly observations	Mean Temperature (ºC)	Mean FB (Kg)	Qty. of fertilizers / four month (Kg)	N / four month (Kg)	IFB (Kg)	AFN (%)	% Contribution (IFB Based)	RGR
	Cow dung: Initial fish biomass at the time of stocking 4.345 (Kg)							
1	19.34	7.535	11.303	0.015	3.19	0.47	8.14	0.551
2	17.68	22.075	33.113	0.044	14.54	0.30	37.11	1.075
3	29.52	43.531	65.297	0.087	21.45	0.40	54.74	0.679
Final		**73.14**	**109.73**	**0.146**	**39.18**	**1.17**		
	Poultry manure: Initial fish biomass at the time of stocking 4.326 (Kg)							
1	18.86	8.457	11.678	0.014	4.13	0.33	16.61	0.670
2	16.41	14.74	20.354	0.025	6.29	0.39	25.31	0.556
3	29.66	29.187	40.278	0.049	14.43	0.33	58.31	0.683
Final		**52.38**	**72.31**	**0.088**	**24.85**	**1.05**		
	Nitrophose: Initial fish biomass at the time of stocking 5.073 (Kg)							
1	19.52	6.891	1.348	0.01	1.81	0.55	10.12	0.307
2	17.62	13.034	2.549	0.027	6.14	0.43	34.34	0.638
3	30.15	22.966	5.210	0.043	9.93	0.43	55.53	0.567
Final		**42.89**	**9.10**	**0.08**	**17.88**	**1.41**		
	Urea: Initial fish biomass at the time of stocking 4.515 (Kg)							
1	19.00	6.478	0.85	0.012	1.968	0.60	12.78	0.361
2	17.57	12.118	1.59	0.024	5.64	0.42	36.64	0.626
3	29.77	19.913	2.62	0.039	7.79	0.50	50.61	0.497
Final		**38.51**	**5.06**	**0.075**	**15.39**	**1.52**		

Mean FB (Mean fish biomass), Qty of fertilizer (Quantity of fertilizers / Quarter, N/ four month, IFB (Increased fish biomass (gm), AFN (adequate fitness of nitrogen)

* 1= Sep. to Dec. growth, 2 = Jan. to April growth, 3 = May to Aug. growth

DISCUSSION

Fertilization of fish pond is the simples and most economical way of achieving better production by enriching pond with micro and macroscopic flora and fauna. It assures a more hygienic intensification of production than artificial feeding. Fertilization increases fish production without a risk of dietary diseases. Its main aim is to increase the quantity of natural food for fish (Hepher, 1963). Hall *et al.* (1970) reported that primary productivity was 10-15 times less in untreated ponds, than in fertilized ponds and supplemented pond with different nitrogen sources. The ability of conversion of provided nitrogen (form fertilizers) into fish weight gain through the enhancement of primary products (Planktonic biomass) is expressed as adequate fitness of nitrogen (Mahboob *et al.*, 1995). The average adequate fitness of Nitrogen (AFN) during the whole study period was recorded maximum (1.32 %) of fishes reared in Urea treatment. The best AFN of fish under the enrichment of Urea could be due to direct utilization of nitrogen and 5512.56 gm of increased fish yield was obtained followed by 1.07 % of AFN, which gave 8989.12 gm of increased fish yield in Nitrophos. Moreover, it may attribute that these two fertilizers are synthetically made and easily dissolve in pond water. At the end of study 13297.74 gm (average increased fish yield) was obtained when 109715.55 gm (in experimental pond) of Cowdung was used against which 0.99 % of AFN recorded. The AFN of fishes in pond enriched with 13297.74 gm (experimental pond) of Poultry manure was 0.96 % and 10498.25 gm (average increased fish yield) of increased fish yield was obtained. The present results were contradicted with the findings of Rashid (1988) who illustrated that overall AFN of fish N: P: K. fertilization was the best (0.1133) which differed significantly from the other treatments i.e. droppings of broiler, layer along with artificial feed. Javed *et al.* (1989) reported N: P: K. (20:20:3) to be the best means for the incorporation of nitrogen into fish weight significantly Mahboob *et al.* (1995) concluded that among artificial feed, broiler manure buffalo manure and N: P: K. (25:25:0), artificial feed was the best regarding incorporation efficiency of Major carps, Chinese carps and Common carp. The present findings regarding temperature effect on fish yield are in accordance with the results of Chiba (1971) who observed maximum growth rate when temperature of pond was maximums. The temperature was one of the only factors which effect the seasonal distribution of population of copepods in Kinjhar Lake as described by Baqai *et al*. (1973). Garg and Bhatnagar (1999) suggested total optimum growth of fish many coincide with the temperature because it maximizes the metabolic efficiency of fishes. Jinghran (1982) stated that major carps thrive well in temp range 18.3-378 °C while the grass carp, silver carp and common carp preferred temperature below 30 °C Annual variation in temperature have a great impact on primary productivity and also spee up the chemical change in water and soil.With the addition of nitrogen, proportionally increase in fish yield was obtained. Zafar (1987) reported significantly positive correlation between increase in fish biomass and dry weight of planktonic biomass under poultry manure fertilization. However, the results of Mc Queen and Lean (1987) contradict with the present findings. They reported positive correlation with temperature and negative correlation with nitrate nitrogen, total inorganic nitrogen and the ratio of nitrate nitrogen and total phosphate. It is not necessary that quarterly addition of nitrogen released by fertilizers may lead the subsequent increase of fish biomass rather than the quality of fertilizers. Both the organic fertilizers provide suitable ecological conditions for growth of phytoplankton which ultimately utilized by experimental carps that produced maximum fish yield at the end of year (cow dung 72.14 kg and poultry manure 128.53 kg) where as only 42.89 kg and 27.60 kg fish yield was harvested by inorganic fertilizer i.e. Nitrophos and Urea. Rate of increased fish biomass with respect to first, second and third quarters, it may be attributed that at the ending of experiment mean temperature range between 29.52 – 30.15ºC. Substantial qualities of primary producers were formulated particularly in ponds treated with cow dung and poultry manure. These results are in agreement of finding of Sheri *et al*. (1986) who claimed that the best growth of major carps was recorded within the water temperature range of 29.0–35.0ºC. However, Javed and Sial (1991) obtained maximum fish yield at water temperature range between 30.5–33.74ºC. These outcomes show the nutrient profile in tested fertilizers that help in the creation of microscopic flora with ultimately incorporated to enhance the body size of carps. Schroeder (1978) also reported the same that manure could not directly consume by the fish but helped in production of plankton which are eaten by the fish. The eco-location of using organic fertilizers as well as nature of pond soil also has some effects in the production of natural feed. Rappaport and Sarig (1978 a & b) reported the same result as they were successfully obtained maximum carp productions by using chicken droppings and cowdung at different locations.

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