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Effect of Inorganic Fertilization on the Zooplankton Production in Fresh Water Pond

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Abstract— *Zooplankton production in newly constructed fish pond fertilized with Nitrogen, Phosphorus and Potassium (N: P: K) and urea fertilizer were compared with unfertilized ponds. Zooplankton production was significantly more ($P \leq 0.05$) in fertilized system than in the unfertilized systems. The Zooplankton fauna was generally dominated by rotifers and copepods. Also the fertilization had no significant effect ($P \leq 0.05$) on the water chemistry.*
Keywords— Inorganic Fertilization, Water Pond.

I. INTRODUCTION

Fertilization is as important for fish cultivation as it is in agriculture because of the increasing mineralization of the pond system, which provides adequate nutrients for plankton growth. The photosynthesizing micro-organisms of the plankton are referred to as the phytoplankton while the non photo-synthesizing component is the zooplankton.

Zooplankton form the most valuable food resource in any aquatic system for fish production. It is produced at almost no cost, replaces costly supplementary feed and it is rich in protein and vitamins (Hepher and Pruginin, 1981). It is worthwhile, therefore to increase the production of this natural food (zooplankton) in the pond as such as possible to allow for an increase in total yield. This can be achieved with the use of fertilizers (inorganic or organic). However care has to be taken with the application i.e. strictly according to the standard dosage so as not to foul up the system.

The study is aimed at investigating the effect of inorganic fertilizers on zooplankton production in fresh water ponds.

II. MATERIALS AND METHODS

Pond fertilization: Six 0.2ha newly ponds of Nigerian Institute for Oceanography and Marine Research out station at Sapele Delta State Nigeria were used for the experiment. Three of the ponds (A, B and C) were fertilized initially with N:P:K (15:15:15) at a rate of 125kg/ha and followed a week later with urea fertilizer 250kg/ha (Charkroff, 1976).while pond (D, E and F) were not fertilized which serves as control.

Zooplankton Sampling: Zooplankton sampling commenced two weeks after the first fertilization. Plankton samples were collected daily for two weeks with fine meshed nets of 154ym. Twenty millimeters (20ml) of the concentrate volume was then preserved by adding few drops of 4% formalin. Three drops of lugol solution was then added to the plankton sample and left for twenty four hours. After which the sample was reduced to ten millimeters (10ml) by decanting. The supernatant aliquot (Adeyemo, 1991).

The physico-chemical parameters (temperature, turbidity, hydrogen ion concentration, and dissolved oxygen nitrate concentration and phosphate concentration of the sampled ponds were also taken (Table 1)

Zooplankton Analysis: The 1ml Sedgwick-rafter counting chamber was filled with the concentrate sample, covered with a cover slip and examined under a calibrated microscope at low power. For rotifers, zooplankter observed was counted, and recorded. Counting was done five times per sample to ensure that all the plankton were counted. For the crustaceans (Cladocera and copepod), micropipette was used in transferring them into glycerol on a clean glass slide. Fine tungsten needle was used to dissect cut parts that are of taxonomic importance. The dissected crustacean was later examined under a calibrated compound microscope and recorded.

Identifications and Estimation of Abundance: Identifications of the zooplankton species were made by reference to Green (1960, 1962); Imevbore (1965): Egborge (1972, 1981); Pontin (1978); Jeje and Fernandi (1986); and Adeyemo (1991). The average abundance of each species of zooplankton was estimated using the formula;

$$: A \; \frac{YZ}{ax}$$

A. = Average number of zooplankton species per liter

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Y. = Average number of zooplankton species per sample
Z. = Concentrate volume (ml)
a. = Original volume (liter)
x. = Volume of counting chamber (ml).

III. RESULTS

Checklist of the zooplankton. Fourteen zooplankton species were identified. These consist of one species of Cladocera, three species of Copedpda and ten species of Rotifera. The checklist of the species is as follows:

Phylum Arthopoda
Class Crustancea
Subclass Branchiopodia
Family Daphnidae
Dsphnialongispina Muller
Order Copepoda.
Family Cyclcpoida

MicrocyclopsrubellusLilljeberg
MicrocycolopsvaricansSars
Thermocyclopscrassus Fischer
Phylum Rotifera
Class Monogononta
Family Asplanchnidae

Asplanchnspriodonta G00se
Family Branchionidae

Branchionusangularis Goose
Branchionuscalycifiorouscalyciflorousfall as
Branchionusleydigirotundus (Rousselet)
Branchionusurceolatrisbennini (Leissling)
Branchionusfalcatusfalcatus Zacharias
Notholcasquamula (muller)
Family Lecanidae
Lecane (Monostyla) lunaris Ehrenberg
Lecane (monostyia) bulla Gosse
Lecaneluna Muller

Abundance. The data on mean zooplankton abundance is presented in Table 1. The abundance ranged from 100 org/liter to 8,000 org/liter. Rotifers were more abundant than Copepods and the Cladocera. Zooplankton was more abundant in fertilized ponds (A, B and C) than the unfertilized ponds (D, E and F). Zooplankton abundance was significantly more ($P \leq 0.05$) in the fertilized ponds than in the unfertilized ponds.

Table.1: Estimated Mean Abundance of Zooplankton Species in the Sampled Ponds.

		Fertilized Ponds			Unfertilized Ponds		
S/NO	Species	Pond A (org/I)	Pond B (org/I)	Pond C (org/I)	Pond D (org/I)	Pond E (org/I)	Pond F (org/I)
1.	Daphnia longispina	100±20	1,100±100	600±435.9	200±173.2		
2.	microcyclops ribellus	400±70	800±264.5				
3.	Microcyclops varicans		300±264.5	900±360.5		100±34.6	
4.	Thereocyclops crasuss			200±100		100±34.6	
5.	Asplanchua priodosta	600±1802.7	5,000±178.2	1,000±264.6	300±173.2	400±200	100±34.6
6	Branchionus angularis	7,000±1732.1	8,000±1732.1	3,000±26496	1,000±400		
7.	Branchonus scalyciflorusca	4,000±2645.7				680±173.2	
8.	B. Leydigi rotundus		1,400±400	1,600±360.6			200±173.2
9.	B. Urceolaris beanini	1,800±1216.5		1,000±264.6			
10.	B. Falcatus falcatus	1,800±200	5,000±1,000	3,000±264.6	400±264.6		100±34.6
11.	Notholca squamulas	800±173.2					
12.	Lecane(Nonontyla lunaris			400±200			
13.	Lecane (Nonostyla) balla	700±435.8					
14.	Lecane luna	1,300±416.3	100±264.6		200±100	200±100	300±100

$P \leq 0.05$.

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Species Occurrence. Table 2. Shows the occurrence of zooplankton species in the sampled ponds. The number of species per pond varied from four to ten and these values respectively corresponds to about 28.6% and 71.4% of the total number of recorded species. The highest, was recorded from a fertilized pond (Pond IA) while the least (four) occurred in an unfertilized pond (Pond F)

Table.2: The Occurrence of zooplankton Species in the Sampled Ponds.

S/NO.	Species	POND A	POND B	POND C	POND D	POND E	POND F	Frequency of Occurrence of Species
1.	Daphnia longispna	X	X	X	X			66.7%
2.	Microcycl0psrubellus	X	X					33.3%
3.	Microcycliosvaricans		X	X		X		50.0%
4.	Theraocyclops crassuss			X		X		33.3%
5.	Asplanchnap riodonta	X	X	X	X	X	X	100%
6.	Branchionus angularis	X	X	X	X	X		66.7%
7.	Branchionus Calyciflorous	X				X		33.3%
8.	B. Leydigi rotundus		X	X			X	50%
9.	B. urceolaris beaniti	X		X				33.3%
10.	B. falcatus falcatus	X	X	X	X		X	83.3%
11.	Notholens quajula	X						16.7%
12.	Lecane (Nonostyla) lunaris			X				16.7%
13	Lecane (Nonostyla) balla	X						16.7%
14.	Lecane luna	X	X		X	X	X	83.3%
	Frequency of occurrence of zooplankton per pond	71.4%	57.1%	54.3%	35.7%	35.7%	28.6%	

Water Chemistry: Table 3 shows the physic-chemical characteristics of the ponds. However, the parameters were not significantly different ($P \leq 0.05$) as a result of the application of fertilizers.

Table.3: Mean Values of the sampled physic-chemical parameters.

Pond	Water temperature 0C	pH	Dissolved oxygen (mg/L)	N0 3 mg/L	P04 mg/L
A	31.0±0.82	6.5±0.25	9.45±0.47	0.04±0.03	0.14±0.11
B	31.0±1.41	65±0.45	10.8±0.47	0.02±0.02	0.13±0.01
C	30.0±2.10	6.7±0.50	7.05±0.01	0.02±0.01	0.11±0.09
D	31.0±0.82	6. 1±0.08	6.2±0.23	0.002±0.003	0.09±0.12
E	31.5±1.41	5.8±0.50	6.1±0.03	0.003±0.002	0.10±0.09
F	29.7±0.21	6.0±.42	6.5±0.25	0.004±0.002	0.10±0.16

IV. DISCUSSION

The use of fertilization in fish ponds is not new. It has been used for centuries to provide basic nutrient components needed for rapid development of plankton. The increase in primary productivity following fertilization usually results in greater zooplankton abundance (Boyd, 1982). This is evident in the zooplankton population that was significantly more ($P \leq 0.05$) in the fertilized system than the unfertilized system in the study. The same finding was also reported by McIntire and Bond (1962) using inorganic fertilizer and Dendy *et al* (1968) recorded maximum density of zooplankters in fertilized ponds of Alabama. Similar

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observations include that of Hall *et al*. (1970) with high turnover ratio of zooplankton in fertilized ponds than the unfertilized and Sharma *et al*. (1990) with a record of significant zooplankton production ($P \leq 0.05$) after fertilization with inorganic fertilizer.

The observed zooplankton fauna was dominated by the rotifers followed by the copepods and with only one species of Cladocera. This confirms the findings of Jeje and Fernando (1986) that rotifers and copepods are the most widely distributed of all the zooplankton and O'Brien and De Moyeis 1974, cited by Sharma *et. al*. (1990) found that mineral fertilizers (N:P:K and Urea have inhibiting effects on the plank tonic Cladocera. Also from the observed physic-chemical parameters. Its evident that there was no significant difference ($P \leq 0.05$) between the fertilized and unfertilized system. Although, there was a slight increase in the pH of the fertilized system, an increase like this was observed by Lewkowicz and Lewkowicz (1976) and Sharma *et.al* (Op.cit.) using inorganic fertilizer generally inorganic fertilizer increases pH (Sharma *et.al*. 1987). Again, no significant influence was seen in the orthophosphate and nitrate concentration of the pond as a result of the application of the fertilizers. Similar result were observed by Wrobel (1962), Sharma et al. (1990) and Delince (1992). The insignificant influence of the fertilizers on the orthophosphate concentration in the pond after fertilization has been attributed to the sorption of the excess into the sediment (Marsden, 1989). Also short lived peaks of ammonium and nitrate in the pond following fertilization results in the insignificant effects of the fertilizers on the nitrate concentration (Bouldin *et. al:* 1974).

In conclusion, it can be inferred that N.P.K. and Urea fertilizer when applied strictly according to the standard dosage increases production of zooplankton without a significant effect on the water chemistry.

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