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EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON NATURAL FOOD COMPOSITION AND PERFOMANCE OF AFRICAN CATFISH (*CLARIAS GARIEPINUS*) FRY PRODUCED UNDER ARTIFICIAL PROPAGATION

BY

SEBASTIAN .S. MOSHA

USAID FROM THE AMERICAN PEOPLE

iAGRI Innovative Agricultural Research Initiative

SOKOINE UNIVERSITY OF AGRICULTURE "1984" ARDHI NI HAZINA

Introduction

- In Tanzania African catfish (*Clarias gariepinus*) is one of the common cultured sp.
- Its demand increases as;
  - food,
  - control over-population in tilapia ponds
  - bait for the Nile perch fishery.
- Catfish farming started during the colonial *era* but it has remained undeveloped.
  - Due to unavailability of quality feeds and seeds.
- Thus, most fish famers have driven to find alternatives such as fertilizers application.

Map of Tanzania


C. gariepinus

Problem statement and Justification

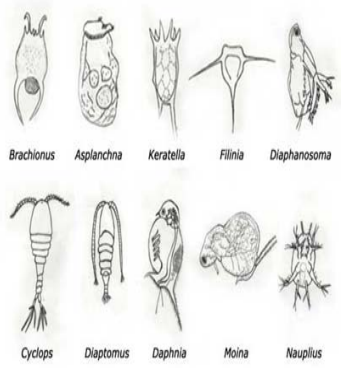
- Rearing of *C. gariepinus* larvae to juveniles has proved to be challenging;
  - small size and lack of functional digestive system.
- Great losses are in the hatchery, as a fry weans from yolk absorption to exogenous feeding.
  - inability to accept large sized feeds and assimilate protein from dry formulated diets .
- *Artemia* constitutes an excellent starting food in larviculture of *Clarias gariepinus*.
  - High cost
  - not available in developing countries especially in rural areas

C. gariepinus larvae

Problem statement and Justification Cont…

- Provision of live feeds to fish larvae is important aspect;
  - supply nutrients and enzymes for digestion
- Fertilization in fish ponds/tanks is known worldwide to improve pond productivity;
  - promoting the growth of phytoplankton and increasing natural food available to fish
- Among fertilizers, chicken manure and di-ammonium phosphate (DAP) fertilizers were chosen;
  - very cheap and locally available to fish farmers.
  - contains a good combination of nitrogen and phosphorus in different proportions
  - increases the quantity of primary producers.

Phytoplankton



Zooplankton

Problem statement and Justification Cont…

- A lot of progress has been made so far in aquaculture,
  - larvae rearing remains the bottleneck in *C. gariepinus* production.
- Therefore, the use of natural live feed at earlier stage of fry development seems to be one of the solutions to improve growth performance and survival.

Objectives

Objectives were to:

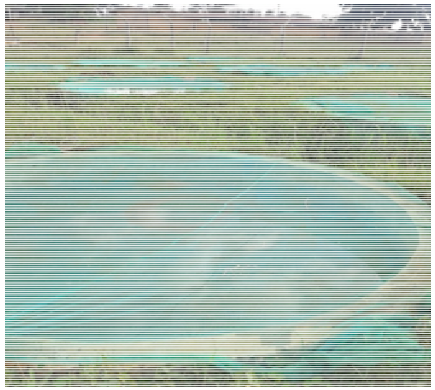
- Determine the abundance and diversity of different species of live food produced in tanks applied with chicken manure and DAP.
- Assess the growth performance of the catfish fry produced in tanks applied with chicken manure and DAP at different stocking densities.
- Evaluate the survival rate of the catfish fry produced in tanks applied with chicken manure and DAP at different stocking densities.
- Examine the water quality parameters in tanks applied with chicken manure and DAP at different fry stocking densities

Materials and Methods

Experiment 1: Determination of Abundance and Diversity of Natural Food.

- 9 concrete tanks (7m^2 each) were laid with 10cm of soil and filled with water to a depth of 0.8m.
- Three treatments:
  - 2kg of chicken manure, 42g of DAP fertilizer and no fertilizer (control) were randomly assigned to the tanks.
- Each treatment was replicated three times and all tanks were covered with nets

Concrete tanks with soil



Tanks covered with nets

Materials and Methods Cont…

Water sampling

- 1 week after fertilization water samples were collected with a 10L bucket from 4 points within each concrete tank.
- Placed into a plankton net with 20µm mesh size and left for about 20min.
- Concentrated sample from plankton net was transferred into 200 ml plastic bottles.
- Five drops of 70% alcohol were added to each sample to fix the organisms and taken to Faculty of Veterinary Medicine Laboratory
- Phytoplankton and Zooplankton abundance were calculated using the formulas as described by Greenberg *et al.* (1992) and Wetzel and Likens (1991).

Water filtering

Plankton count under microscope

Materials and Methods Cont…

Experiment 2: Determination of Growth and Survival of African Catfish Fry, *Clarias gariepinus*

- **Artificial propagation** was conducted according to de Graaf and Janssen (1996).
- A well distended, swollen abdomen female weighing 355g and a male weighing 350g were selected.
- A male weighing 344g was killed to get pituitary gland (0.09g)
  - ground in a porcelain mortar and mixed with salt solution (9 g of common salt/litre of water).
- A syringe was filled with the solution and female was injected intramuscularly to induce final maturation and ovulation of eggs.
- Stripping was carried out after 18 hrs of pituitary hormonal injection.

Brood stock selection

Egg stripping

Materials and Methods Cont…

- The sperm obtained by killing a male and testes (1.6g) were rapidly cut into small pieces using a scissor into mortar
- The milt was pressed out with a pestle and mixed with eggs by stirring with a feather
- Eggs were spread out onto mosquito netting (mesh size 0.5 mm) placed in an incubator and eggs hatched after 27hrs at 28°C
- The hatchlings passed through the screen while shells remained on the screen.
- The hatchlings were collected and kept in an aquarium ($0.6m^2$) placed in a dark places for 3 days.
- Larvae were fed 3g of formulated feed (55% crude protein) at an interval of every 2 hrs to satiation for a period of 4 weeks

Cutting of testes

Eggs fertilization

Materials and Methods Cont…

Fry stocking

- *C. gariepinus* fry (1 month old) with average weight of 0.5g ± 0.01g were randomly assigned to treatment tanks.
- Two stocking densities (5fry/m^2 and 10fry/m^2) were used.
- Each stocking density was assigned at once and replicated three times.
- All 18 concrete tanks were covered with plastic nets to prevent predators.
- Fertilization was repeated after every week for a period of 2 months.
- During this period, all treatments were supplemented with the same diet formulated at 25% body weight per day

C.gariepinus fry

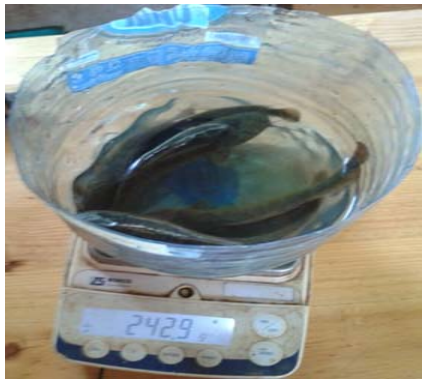
Materials and Methods Cont…

Data collection

- Weights of fry were measured every week at 08:00am by using analytical balance for all 2 months.
- The formula used in determine fry performance were according to Kang'ombe *et al.* (2006).

Water quality

- Temperature (°C) and dissolved oxygen (mg L^{-1}) were measured on daily basis (08:00-16:00hrs) using a multi-probe water checker.
- The pH was measured every day at 08:00hrs using pH meter.
- Ammonia and nitrite (ppm) were calculated once a week by using Salicylate Method and Diazotization Method respectively.



Results

Table 1. Phytoplankton and zooplankton abundance (individuals/L) observed in tanks fertilized with different type of fertilizers (Mean ± SE)

Treatment	Phytoplankton				Zooplankton		
	Chlorophyta	Cynophyta	Euglenophyta	Diatomae	Rotifers	Copepods	Cladocerans
Chicken	52750±10528[a]	18833±3346[a]	9917±1109[a]	10375±2376[a]	157±23[a]	257±8[a]	167±14[a]
DAP	71833±11383[a]	25458±4616[a]	14917±1500[b]	19833±3840[b]	1207±388[b]	667±133[b]	640±69[b]
Control	12542±2648[b]	3333 ± 417[b]	2500 ± 224[c]	1542 ± 384[b]	33± 4[a]	40±10[a]	17±7[a]
P-Values	0.001	0.001	0.0001	0.001	0.004	0.0001	0.0001

Means with different superscript within columns indicate significant differences (Tukey's multiple range test at $p<0.05$).

Results Cont…

Table 2. Shannon-Wiener indices of phytoplankton and zooplankton diversity (individuals/L) in tanks applied with chicken manure DAP fertilizer and no manure application.

Treatments	**Phytoplankton/L**			**Zooplankton/L**		
	H'	H'_{max}	J	H'	H'_{max}	J
Chicken manure	1.1300	1.3863	0.8151	1.0728	1.0986	0.9765
DAP fertilizer	1.1797	1.3863	0.8509	1.0526	1.0986	0.9581
No fertilizer	1.0489	1.3863	0.7566	1.0431	1.0986	0.9494

Shannon-Wiener indices (H') and evenness (J')

Results Cont…

Table 3: Growth parameters and survival observed in chicken, di-ammonium fertilizer and no fertilizer at different stocking densities (Mean ± SE).

Parameters	Initial mean weight (g)	Individual final mean weight (g)	Weight gain (g)	Increase mean weight (g)	Specific growth rate (%)	Survival rate (%)
Stocking densities						
5fry/m²	0.5±0.01	24.1±2.1[a]	6.3±0.4[a]	90.7±10.9	21.6±1.7[a]	97.8±0.9[a]
10fry/m²	0.5±0.01	18.3±2.1[b]	4.6±0.4[b]	80.6±10.9	16.5±1.7[b]	87.2±0.9[b]
P-values	0.17	0.047	0.008	0.62	0.034	0.0001
Fertilizers						
Chicken manure	0.5±0.01	25.6±2.5[a]	6.5±0.5[a]	90.8±13.4	22.5±2.1[a]	92.1±1.2
DAP Fertilizer	0.5±0.01	20.5±2.5[a]	5.2±0.5[a]	84.3±13.4	18.7±2.1[a]	93.9±1.2
No fertilizer	0.5±0.01	17.5±2.5[b]	4.5±0.5[b]	81.7±13.4	15.8±2.1[b]	91.5±1.2
P-values	1.0	0.047	0.034	0.886	0.042	0.32
Stocking density*Fertilizer						
5fry/m²*chicken manure	0.5±0.01	29.2±3.6	7.6±0.8	92.6±19.0	25.6±2.9	93.3±1.7[a]
5fry/m²*DAP Fertilizer	0.5±0.01	24.3±3.6	5.9±0.8	90.9±19.0	20.6±2.9	100.0±1.7[b]
5fry/m²*no fertilizer	0.5±0.01	18.8±3.6	5.2±0.8	88.5±19.0	15.6±2.9	100.0±1.7[b]
10fry/m²*chicken manure	0.5±0.01	21.9±3.6	5.4±0.8	89.0±19.0	19.6±2.9	90.8±1.7[a]
10fry/m²*DAP Fertilizer	0.5±0.01	16.7±3.55	4.4±0.8	77.7±19.0	16.7±2.9	87.9±1.7[a]
10fry/m²*no fertilizer	0.5±0.01	16.3±3.6	3.9±0.8	74.9±19.0	13.1±2.9	82.9±1.7[c]
P-values	1.0	0.73	0.87	0.95	0.94	0.0001

Results Cont…

Table 4: Water quality parameters observed in fertilizer type and different stocking densities (Mean ± SE).

Parameters	Temp(^{0}C) at am	Temp(^{0}C) at pm	DO(mgL^{-1}) at am	DO(mgL^{-1}) at pm	NO_2 (ppm)	NH_3 (ppm)
Stocking densities						
5fry/m^2	26.8±0.1	28.6±0.1	4.2±0.1	6.2±0.1	0.2±0.07	0.5±0.2
10fry/m^2	26.8±0.1	28.5±0.1	4.3±0.1	6.3±0.1	0.3±0.07	0.5±0.2
P-values	0.61	0.71	0.29	0.43	0.21	0.86
Fertilizers						
Chicken manure	26.7±0.1	28.6±0.1	4.3±0.8	6.1±0.1^a	0.2±0.09^{ab}	0.3±0.2
DAP Fertilizer	26.8±0.1	28.5±0.1	4.3±0.8	6.5±0.1^b	0.4±0.09^a	0.8±0.2
No fertilizer	26.8±0.1	28.6±0.1	4.3±0.8	6.0±0.1^a	0.04±0.09^b	0.3±0.2
P-values	0.78	0.85	0.96	0.016	0.031	0.113
Stocking density*Fertilizer						
5fry/m^2*chicken manure	26.7±0.2	28.7±0.2	4.2±0.1	6.1±0.2^a	0.1±0.1^a	0.4±0.3
10fry/m^2*chicken manure	26.8±0.2	28.5±0.2	4.3±0.1	6.1±0.2^a	0.3±0.1^a	0.3±0.3
5fry/m^2*DAP fertilizer	26.8±0.2	28.5±0.2	4.2±0.1	6.3±0.2^b	0.3±0.1^b	0.9±0.3
10fry/m^2*DAP fertilizer	26.8±0.2	28.5±0.2	4.3±0.1	6.7±0.2^b	0.5±0.1^b	0.9±0.3
5fry/m^2*no fertilizer	26.8±0.2	28.7±0.2	4.2±0.1	6.0±0.2^a	0.02±0.1^c	0.3±0.3
10fry/m^2*no fertilizer	26.9±0.2	28.6±0.2	4.3±0.1	6.0±0.2^a	0.07±0.1^c	0.3±0.3
P-values	0.95	0.88	0.92	0.03	0.018	0.99

Conclusion and recommendation

- Zooplankton abundance were statistically higher in DAP fertilizer compared to other treatments.
- Zooplankton diversity were higher in chicken manure compared to other treatments.
- Growth performance parameters did not differ significantly between chicken manure and DAP fertilizer treatments across stocking densities.
- Survival rate of catfish fry was dependent on stocking density
  - High survival rate was recorded at low stocking density (5fry/m^2) across all fertilizer types.
- Among water quality parameters dissolved oxygen during the afternoon and nitrite depended on fertilizer types.
- Catfish fry should be raised in DAP or chicken manure at low stocking density (5fry/m^2) for better growth and survival in aquaculture practices.

Thank you for your listening