AARM

Aquaculture, CRSP

EFFECT OF FRETILIZATION AND FEEDING STRATEGY ON WATER QUALITY, GROWTH PERFOMANCE, NUTRIENT UTILIZATION AND ECONOMIC RETURN IN NILE TILAPIA (*Oreochromis niloticus*) PONDS

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Presentation Outline

- Introduction:
  - -background
  - -problem statement
  - -objectives
- Materials and methods (brief)
- Results and discussion
- Conclusion

- Nile tilapia being cultured in more than 100 countries
- Semi-intensive culture system is the most prevalent system in Asia
  - Inorganic/organic fertilizer as primary inputs
  - Supplementary feeding with formulated feed
  - Fertilization plus supplementary feeding
- PD/A CRSP involvement in tilapia research

Supplemental feeding in fertilized ponds resulted in significantly higher growth rates and greater yield than fertilization alone (Green, 1992; Diana *et al*., 1994).

Diana *et al*. (1996) concluded that fertilization early in the grow-out, then adding supplemental feed once Nile tilapia reach 100-150 g, is the efficient way to grow large tilapia.

There are concerns:

- Economical viability
  - -excessive increase in variable cost due to the high price of formulated feed
  - -relatively low farm gate price of harvested fish in domestic market

- Nutrient utilization efficiency of the culture system as the fate of the waste generated raises serious environmental concern

Objectives:

- To investigate and compare growth performance, water quality, and nutrient utilization in Nile tilapia ponds with fertilization plus supplementary feeding and fertilization followed by supplementary feeding.

- To investigate and compare economic return in Nile tilapia ponds with fertilization plus supplementary feeding and fertilization followed by supplementary feeding.

MATERIALS AND METHODS

Experimental system: Six 280-m^2 earthen ponds; culture period- 160 days

Two treatments in triplicate each:

(A) Fertilizing ponds throughout the cultural period and feeding Nile tilapia starting from day 80,

(B) Fertilizing ponds until day 80 and feeding Nile tilapia starting from day 80.

Sex-reversed all-male Nile tilapia (23-24 g) were stocked at 3 fish m^{-2}

Fertilization scheme

Urea at rates of 28 kg N ha^{-1} $week^{-1}$

TSP at rates of 7 kg P ha^{-1} $week^{-1}$

Feeding

Nile tilapias in both treatments were fed at the rate of 50% of mean satiation feeding starting from day 80 of the culture period.

50% of mean satiation feeding rate (determined weekly) for each treatment was used over the reminder of the week.

•Mean fish weight was determined at initial and final harvest, as well 40 fish were sampled and batch weight was taken to assess fish growth biweekly.

•Column water samples taken biweekly and analyzed for:

-pH, total alkalinity, TAN, NO2-N, TKN, SRP, TP, and chlorophyll *a* using standard methods

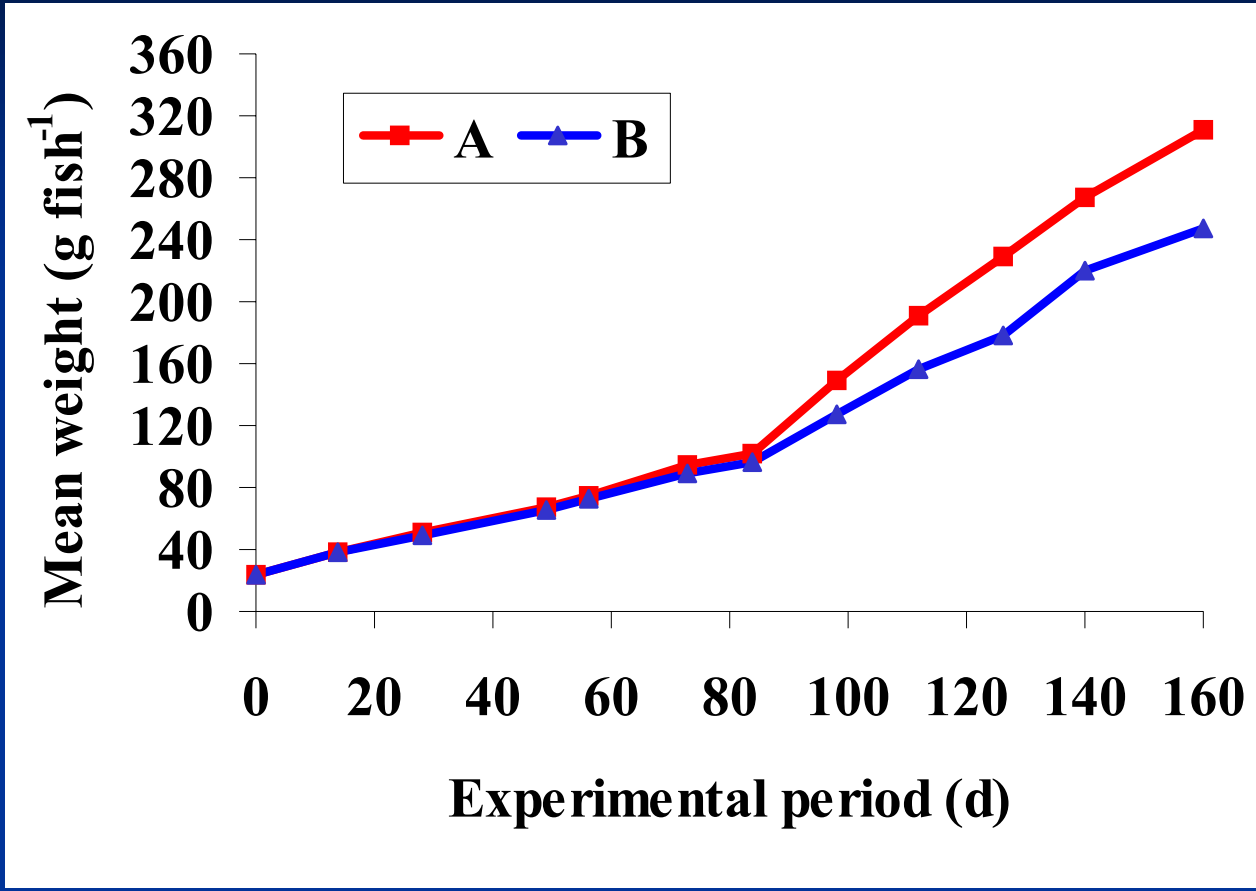
•DO, temperature and pH were measured in situ at 20 cm below the water surface (biweekly)

- Total N and P inputs in ponds calculated based on inputs from fertilizer and pelleted feed, and gain in the harvested fish

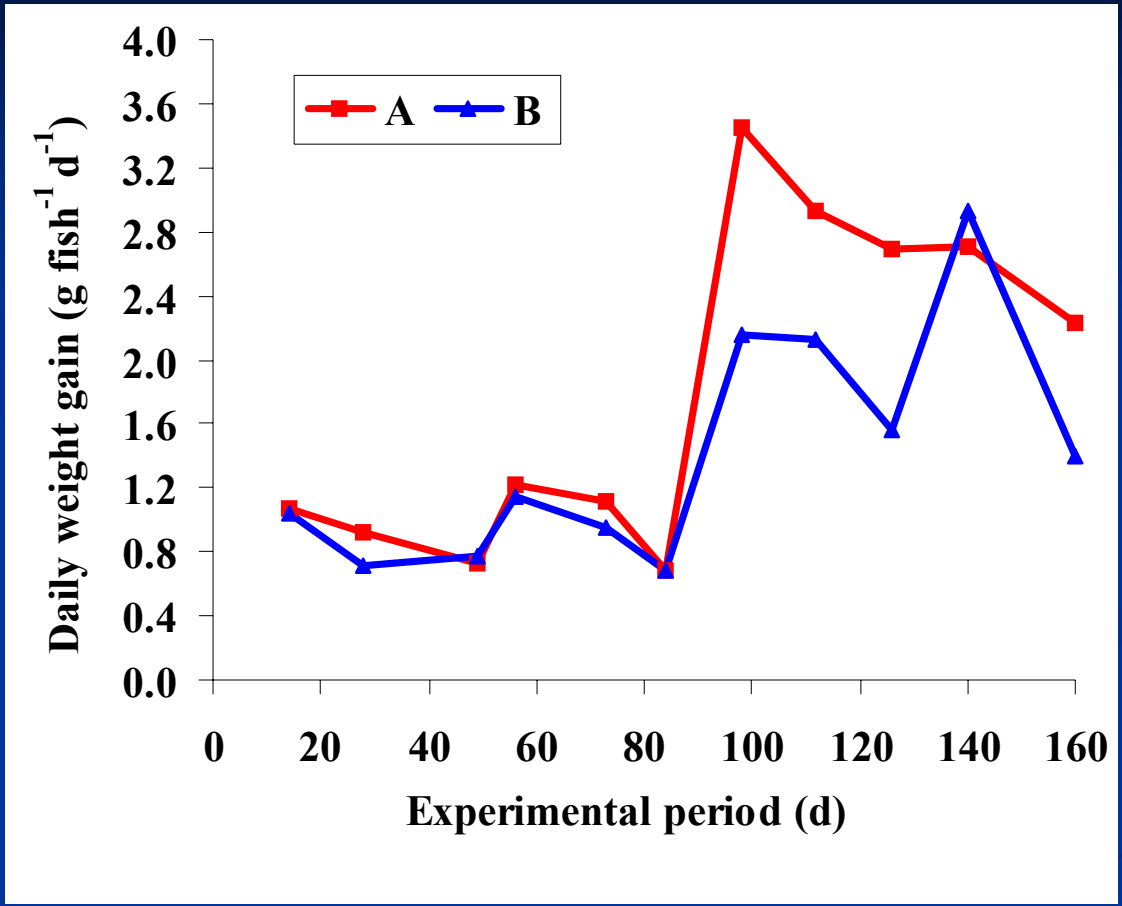
- Economic performance of the two feeding strategies were compared in terms of total variable cost, gross revenue from selling tilapia, and net return (gross revenue-total variable cost)

Items	Price in US$ (US$1 = 40 Baht)
Nile tilapia fingerling	0.009 piece^{-1}
Urea	0.170 kg^{-1}
TSP	0.300 kg^{-1}
Feed	0.500 kg^{-1}
HARVEST NILE TILAPIA	
Size 100-200 g	0.375 kg^{-1}
Size 200-299 g	0.500 kg^{-1}
Size 300-500 g	0.600 kg^{-1}
Size more than 500 g	0.800 kg^{-1}

RESULTS AND DISCUSSION



Mean body weight of Nile tilapia in both treatments over the experimental period



Mean daily weight gain of Nile tilapia in both treatments over the experimental period

Growth performance of Nile tilapia in treatments A and B

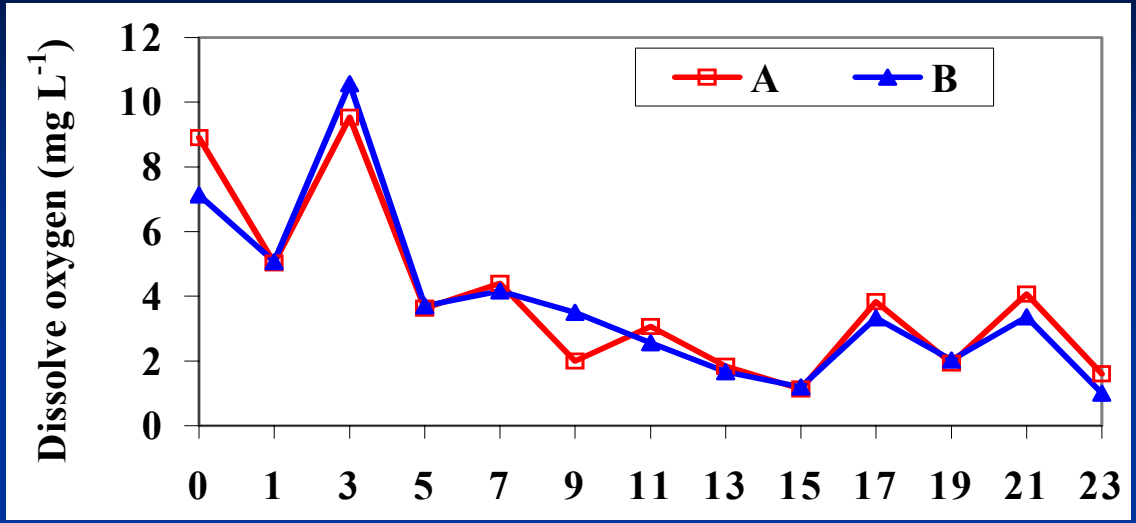
Parameters	Treatment A	Treatment B
Survival rate (%)	87.0±1.3	87.3±2.0
Mean weight (g fish^{-1})	312±1.8^{a}	248±17.5^{b}
Total Weight (kg pond^{-1})	227.8±4.4^{a}	182.4±16.9^{b}
Weight gain (kg pond^{-1})	208.2±4.5^{a}	162.1±17.0^{b}
DWG (g fish^{-1} day^{-1})		
for the 1st 80 days	0.96±0.19	0.88±0.28
for the 2nd 80 days	2.66±0.19^{a}	1.96±0.33^{b}
for the entire culture cycle	1.81±0.01^{a}	1.42±0.22^{b}
Net Yield (t ha^{-1} year^{-1})	16.7±0.4^{a}	13.0±1.4^{b}
FCR	0.87±0.05^{a}	1.10±0.10^{b}

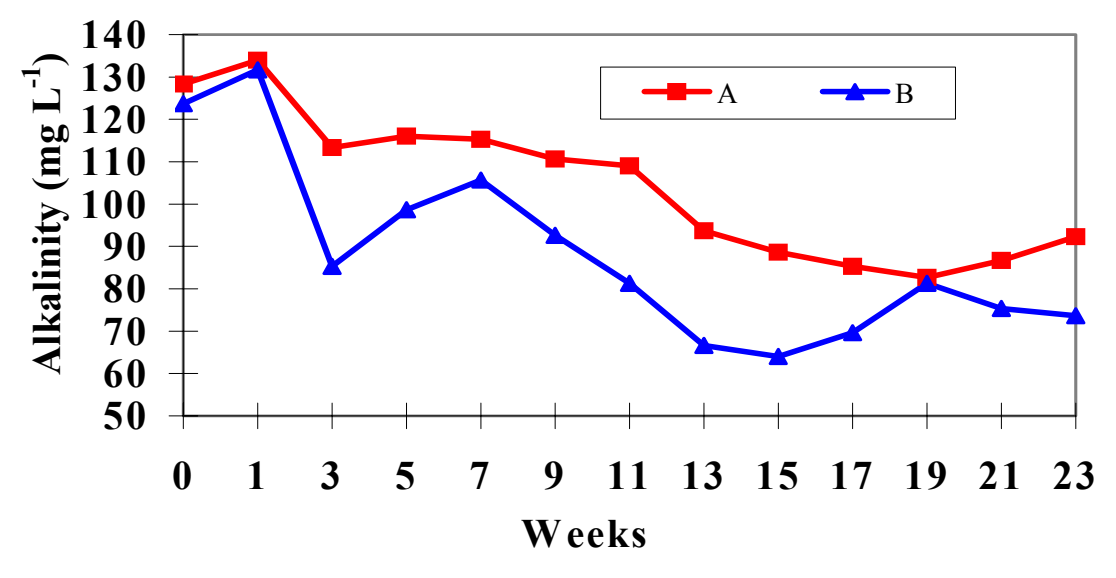
Mean values with different superscripts in the same row are significantly different.

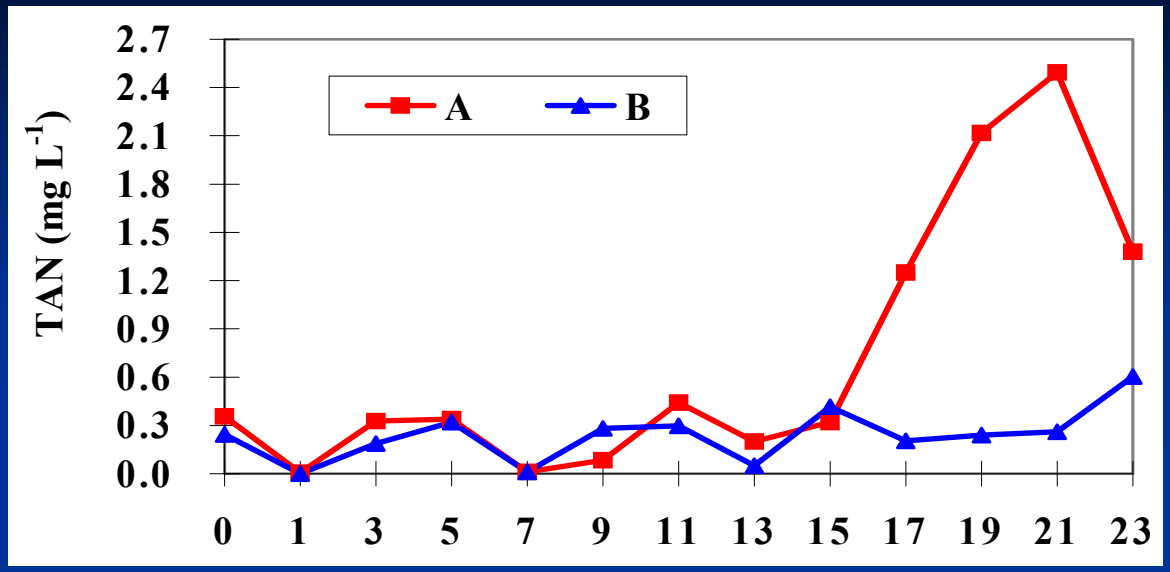
Mean values of water quality parameters

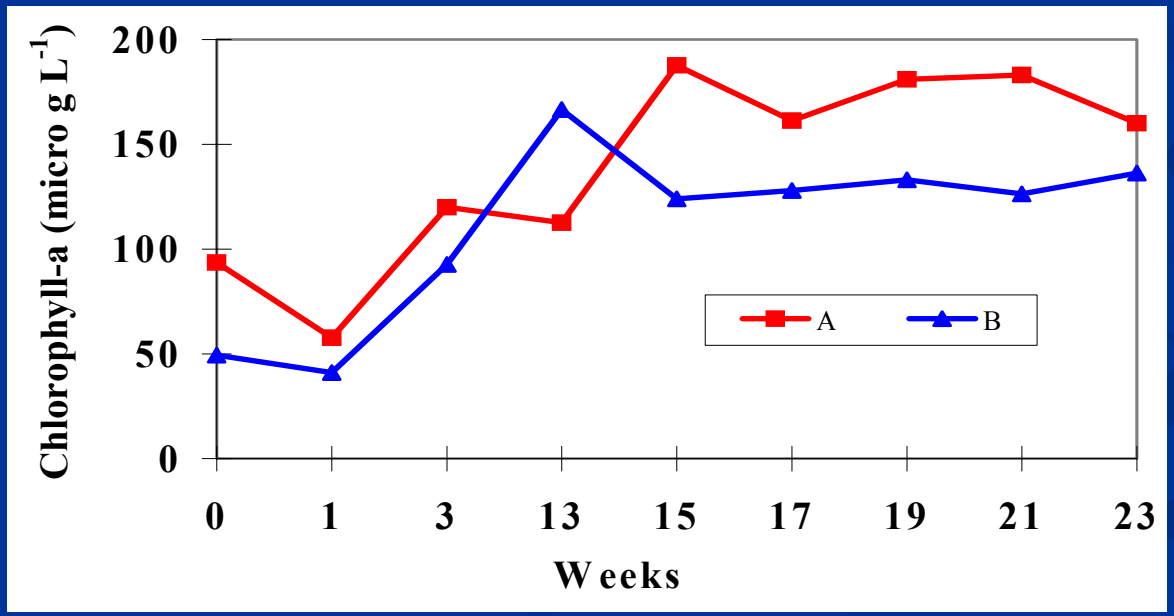
Parameters	Treatment A	Treatment B
DO (mg L^{-1}) at dawn	3.5±0.3	3.5±0.2
Temperature (C)	27.4±1.4	27.4±1.4
pH	7.0-8.7	7.4-8.6
Total alkalinity (mg L^{-1})	104 ± 21.7^{a}	88 ± 2.4^{b}
TKN (mg L^{-1})	5.6±0.3	4.4±0.2
TAN (mg L^{-1})	0.72 ± 0.31^{a}	0.24 ± 0.03^{b}
NO_2-N (mg L^{-1})	0.13±0.02	0.06±0.02
TP (mg L^{-1})	0.57±0.09	0.50±0.06
SRP (mg L^{-1})	0.07±0.03	0.07±0.02
Chlorophyll-*a* (μg L^{-1})	140±36.2	111±15.5
TSS (mg L^{-1})	151±19.1	154±20.2
TVS (mg L^{-1})	45±11.1	42±2.3
Secchi disk visibility (cm)	14.1±1.2	12.8±1.5

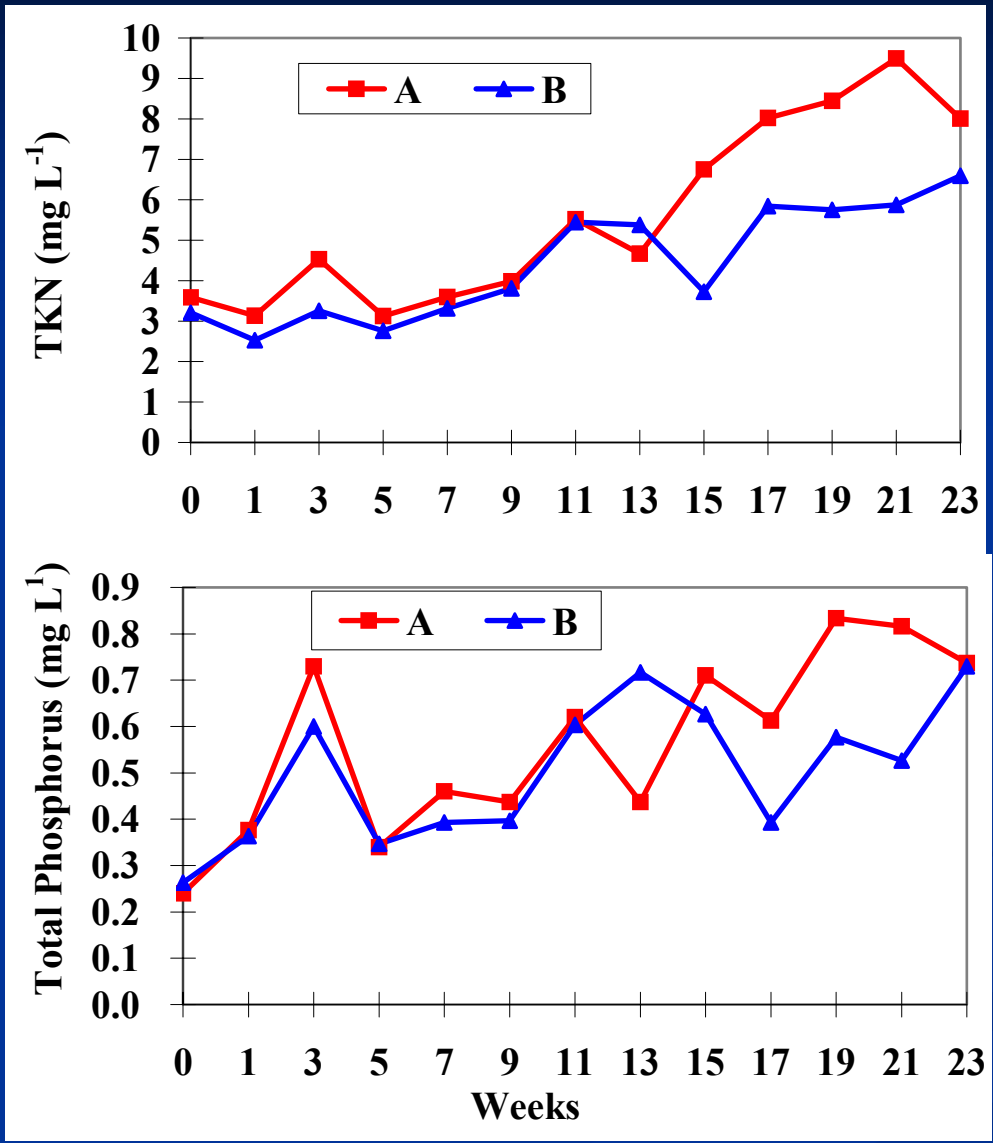
Mean values with different superscripts in the same row are significantly different.


Dissolve oxygen (mg L-1)
12
10
8
6
4
2
0
A
B
0 1 3 5 7 9 11 13 15 17 19 21 23


Alkalinity (mg L-1)
140
130
120
110
100
90
80
70
60
50
A
B
0 1 3 5 7 9 11 13 15 17 19 21 23
Weeks


TAN (mg L-1)
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
A
B
0 1 3 5 7 9 11 13 15 17 19 21 23


Chlorophyll-a (micro g L-1)
200
150
100
50
0
A
B
0 1 3 13 15 17 19 21 23
Weeks


TKN (mg L-1)
10
9
8
7
6
5
4
3
2
1
0
A
B
0 1 3 5 7 9 11 13 15 17 19 21 23
Total Phosphorus (mg L-1)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
A
B
0 1 3 5 7 9 11 13 15 17 19 21 23
Weeks

Comparison of nitrogen and phosphorus inputs and gain

Parameters	Treatment A	Treatment B
Nitrogen (kg pond^{-1})		
Inputs		
Fertilizer	17.99 ± 0.00 (68.1)	9.38 ± 0.00 (53.7)
Feed	8.41 ± 0.41 (31.9)	8.07 ± 0.27 (46.3)
Total	26.40 ± 0.26 (100)	17.45 ± 0.23 (100)
Gain in harvested biomass	4.43 ± 0.19 (16.8)	3.59 ± 0.23 (20.1)
Waste	21.97 ± 0.32 (83.2)	13.86 ± 0.27 (79.9)
Phosphorus (kg pond^{-1})		
Inputs		
Fertilizer	4.60 ± 0.00 (69.6)	2.40 ± 0.00 (55.6)
Feed	2.00 ± 0.10 (30.3)	1.92 ± 0.06 (44.4)
Total	6.60 ± 0.09 (100)	4.32 ± 0.05 (100)
Gain in harvested biomass	0.90 ± 0.11 (13.6)	0.61 ± 0.03 (14.1)
Waste	5.86 ± 0.11 (86.4)	3.71 ± 0.05 (85.9)

Values in the parentheses are the percentages of total nutrient inputs

Comparison of economic returns

Items (Unit: US$ ha^{-1} $crop^{-1}$)	Treatment A	Treatment B
Gross revenue	4,880.7 ± 93.4[a]	3,257.7 ± 301.1[b]
Variable cost		
Fingerlings	270.0 ± 0.0 (6.5)	270.0 ± 0.0 (7.2)
Urea	237.4 ± 0.0[a] (5.7)	123.9 ± 0.0[b] (3.3)
TSP	246.4 ± 0.0[a] (6.0)	128.6 ± 0.0[b] (3.4)
Feed	3,251.5 ± 157.9 (78.4)	3,120.7 ± 104.8 (82.7)
Cost of working capital	140.5 ± 5.5 (3.5)	127.7 ± 3.5 (3.4)
Total	4,145.8 ± 163.5 (100)	3,770.2 ± 108.5 (100)
Net return	734.9 ± 102.6[a] (17.9)	-512.5 ± 206.4[b] (-13.9)

Mean values with different superscripts in the same row are significantly different.

Summary

- Nile tilapia growth performance was better in treatment A than treatment B:

  -higher growth rate, higher weight gain and higher net yield

- Water quality parameters remained in favorable range in both:

  -higher alkalinity, TAN and Chlorophyll-a in treatment A than in treatment B

- Nutrient (N & P) utilization efficiency was better in better in treatment B than A:

  -due to higher (1.5 times) inputs in treatment A than B

- Higher economic return in treatment A than treatment B

Fertilization plus supplementary feeding with formulated feed produced higher yield and higher economic return than supplementary feeding only, and, therefore, should be the preferred strategy to grow large size Nile tilapia

Thank you!