Optimization of Stocking Ratios of the GIFT Strain of Nile Tilapia (*Oreochromis niloticus*) and Freshwater Prawn (*Macrobrachium rosenbergii*) in a Periphyton-Based System

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significance of research

- Fisheries and aquaculture are vital to the national economy in terms of nutrition, income, employment generation and foreign exchange earning
- Periphyton-based aquaculture system is a modern concept and eco-friendly approach in closed water aquaculture
- Periphyton is a preferable natural food for Indian major carps, tilapia and freshwater prawn (*Macrobrachium rosenbergii*)
- Periphyton-based aquaculture systems offer the possibilities of increasing both primary production and food availability for fish, which is an important consideration of its use in resource-constrained countries
- Pond trials demonstrated that fish production from ponds with substrates (for periphyton) was higher than that of substrate free ponds

(cont'd)

- Tilapia is known to be a periphyton grazer in recent years and grew well in substrate-based systems
- Monoculture ponds with freshwater prawn might have been experienced with excessive algal blooms leading to water quality deterioration
- Tilapia may be able to potentially utilize the remaining food resources in freshwater prawn culture ponds
- Therefore, it may be advantageous to culture tilapia and freshwater prawn together in periphyton-based systems
- However, the optimum stocking combination of these two species is unknown, especially in this new system

objectives

- To test the technical viability of a periphyton based polyculture with GIFT and freshwater prawn

- To compare yields from different stocking ratios of GIFT and freshwater prawn in polyculture as well as monoculture of either species in substrate-based system

GIFT

PRAWN

research design

- Site: Farmers’ ponds in rural area of Mymensingh, Bangladesh
- Pond facility: 15 earthen ponds of size ranging from 200 to 300 m^2 with depths 1.5 m
- Culture period: Jul- Dec 2003, 125 days
- Design

		Treatments				
		T_1	T_2	T_3	T_4	T_5
%		100	75	50	25	0
		0	25	50	75	100
density (ha^{-1})		20,000	15,000	10,000	5,000	0
		0	5,000	10,000	15,000	20,000

household pond with substrates

pond management

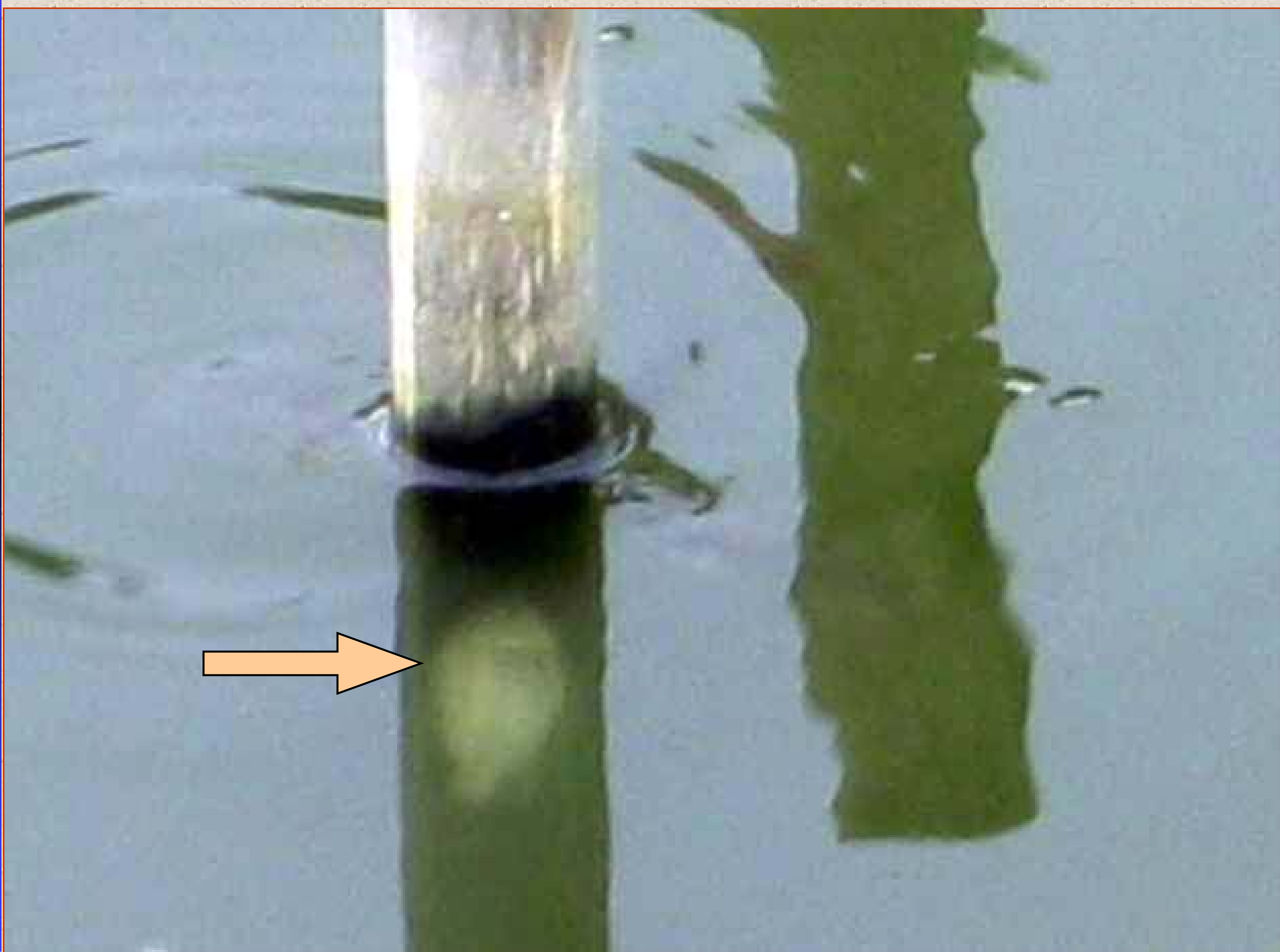
pre-stocking

- Ponds renovation
- Rotenone application: 30g $dec^{-1} ft^{-1}$ water (dec = 40 m^2)
- Liming: $CaCO_3$, 250 kg ha^{-1}
- Bamboo installation: 5.5 poles m^{-2} with mean diameter 6.2 cm (covers 60% of pond surface area)
- Fertilization: cow manure, urea and TSP at 3,000, 100 and 100 kg ha^{-1}

post stocking

- GIFT and prawn were sampled at monthly intervals using lift net
- 3-5% commercial feed of total fish (GIFT+prawn) body weight per day
- Urea- 50 kg ha^{-1}, TSP- 50 kg ha^{-1} fortnightly

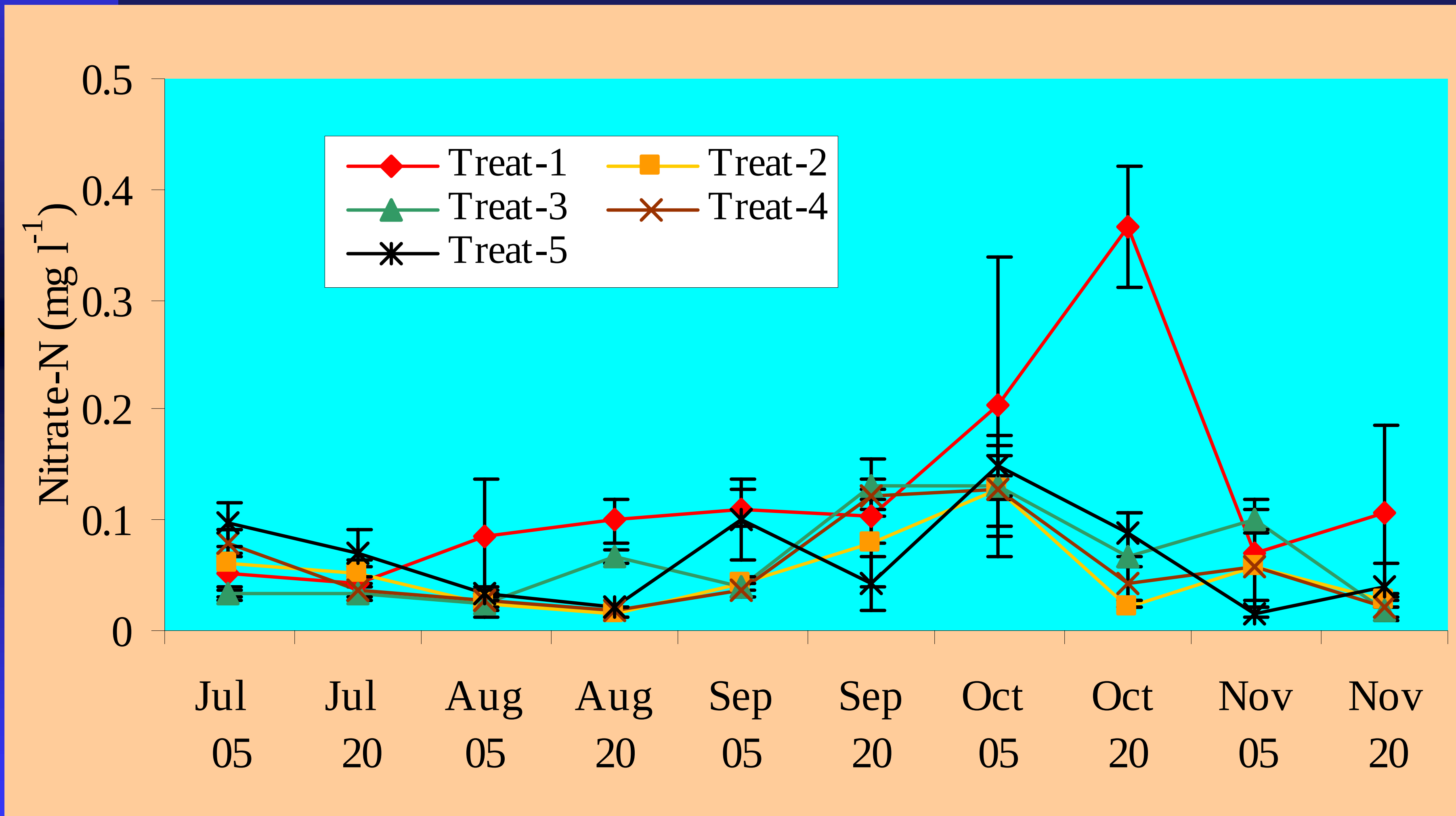
GIFT grazing on substrate



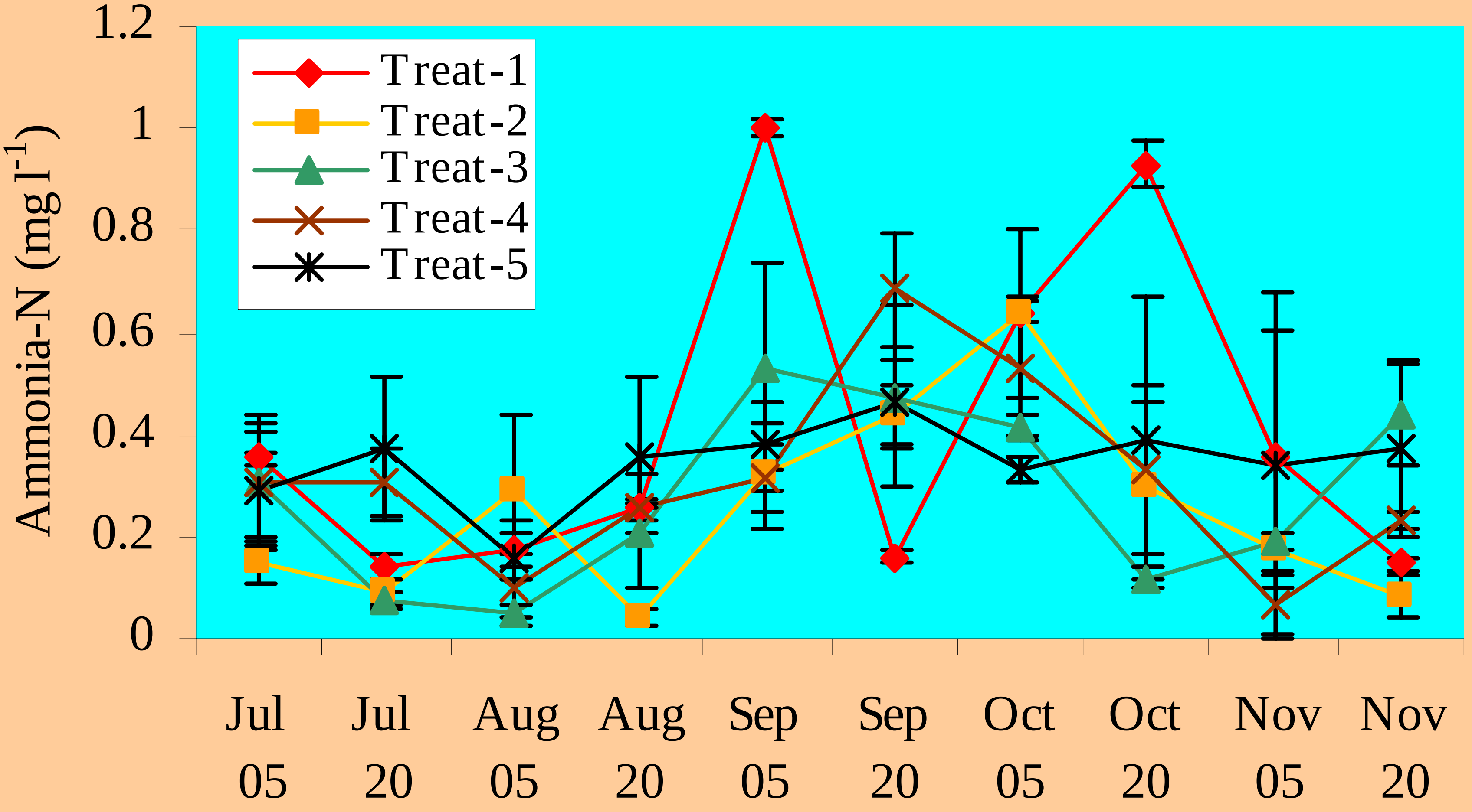
means (and ranges) of water quality parameters

Parameters	Treatments				
	T_1	T_2	T_3	T_4	T_5
Temperature (^{0}C)	28.40 (27-31)	28.17 (26-30)	28.05 (27-30)	27.90 (26-30)	28.40 (25-32)
Secchi depth (cm)	42.60^a (27-67)	38.43^{ab} (23-59)	42.57^a (25-68)	35.80^b (22-50)	38.10^{ab} (26-57)
DO (mg l^{-1})	4.89^c (1.9-9.8)	5.07^{bc} (2.0-7.1)	4.65^c (3.7-6.2)	5.60^{ab} (2.9-6.9)	6.06^a (2.8-9.2)
pH	7.10^{ab} (6.1-8.5)	6.81^b (6.1-9.3)	9.78^b (5.8-7.7)	7.27^a (6.1-9.8)	6.94^{ab} (5.8-9.4)
Nitrate nitrogen (mg l^{-1})	0.095 (0.02-0.36)	0.053 (0.01-0.23)	0.057 (0.01-0.21)	0.057 (0.01-0.17)	0.065 (0.01-0.18)
Ammonia nitrogen (mg l^{-1})	0.415 (0.03-0.81)	0.243 (0.03-0.83)	0.282 (0.04-0.74)	0.314 (0.01-0.78)	0.346 (0.01-0.69)
Phosphate phosphorus (mg l^{-1})	0.268 (0.10-0.63)	0.235 (0.12-0.38)	0.229 (0.12-0.45)	0.258 (0.09-0.63)	0.272 (0.13-0.43)
Chlorophyll *a* (μg l^{-1})	165.69 (70-258)	172.29 (8-320)	161.94 (69-304)	173.71 (54-339)	152.96 (54-297)

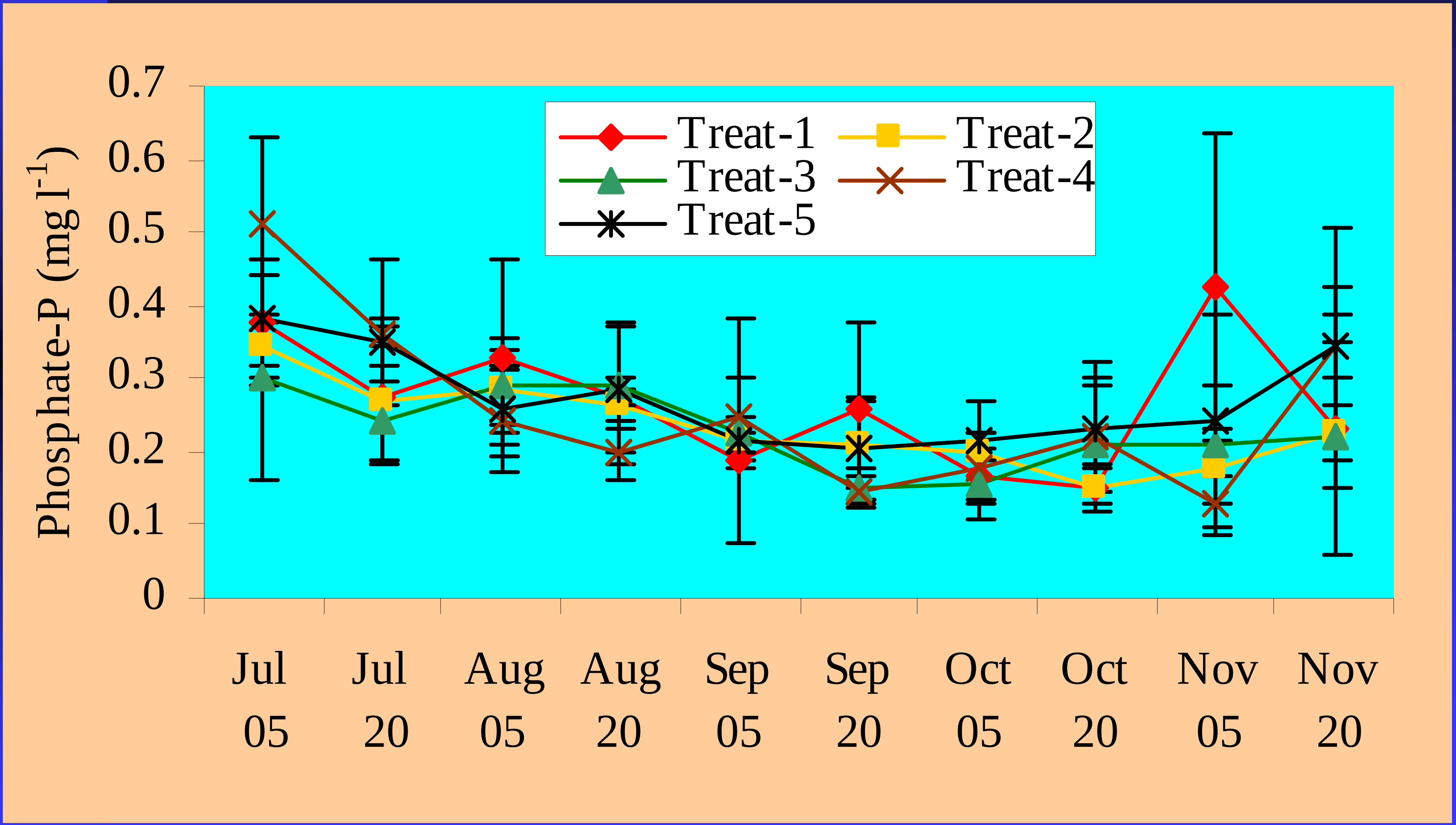
means (±SD) of nitrate-N (mg l^{-1}) in the ponds



mean (±SD) of ammonia-N (mg l^{-1}) in the ponds



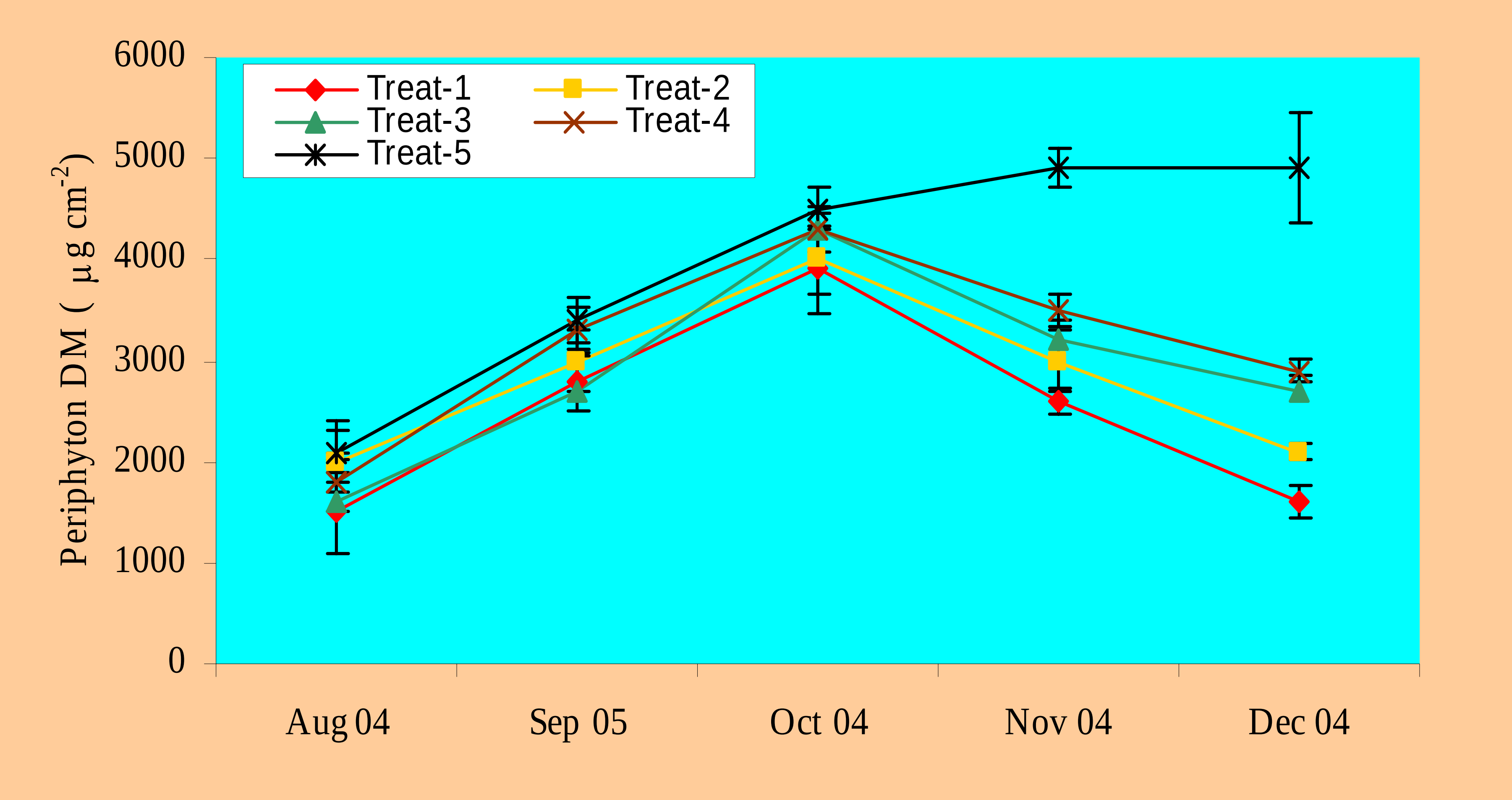
mean (±SD) of phosphate-P (mg l^{-1}) in the ponds



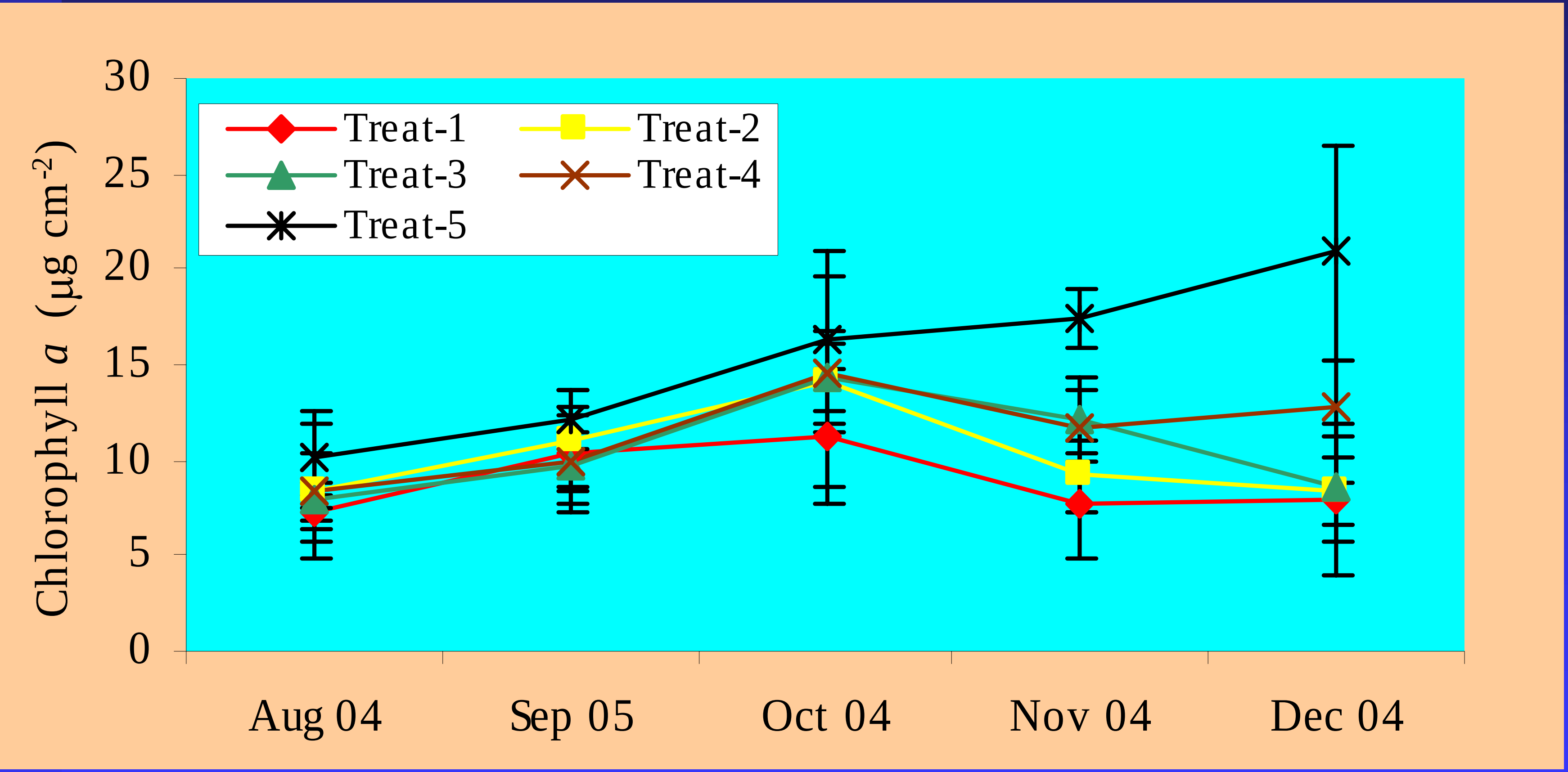
means (±SD) of periphyton biomass and pigment parameters (materials scraped from bamboo substrates)

Parameters	Treatments				
	T_1	T_2	T_3	T_4	T_5
Dry matter ($\mu g\ cm^{-2}$)	2060[b] (779)	2191[b] (910)	2650[b] (1029)	2480[b] (687)	3550[a] (1283)
AFDM ($\mu g\ cm^{-2}$)	1430[b] (539)	1530[b] (501)	1680[b] (580)	1560[b] (437)	2140[a] (656)
Ash (%)	29.94 (5.93)	29.62 (7.55)	34.52 (9.28)	35.94 (9.52)	37.17 (10.79)
Chlorophyll *a* ($\mu g\ cm^{-2}$)	8.898[b] (2.919)	9.434[b] (3.630)	10.506[b] (3.032)	11.471[ab] (2.997)	15.37[a] (5.014)
Pheophytin *a* ($\mu g\ cm^{-2}$)	3.075[b] (0.694)	3.066[b] (0.550)	3.200[b] (0.732)	3.180[b] (0.770)	4.029[a] (1.485)

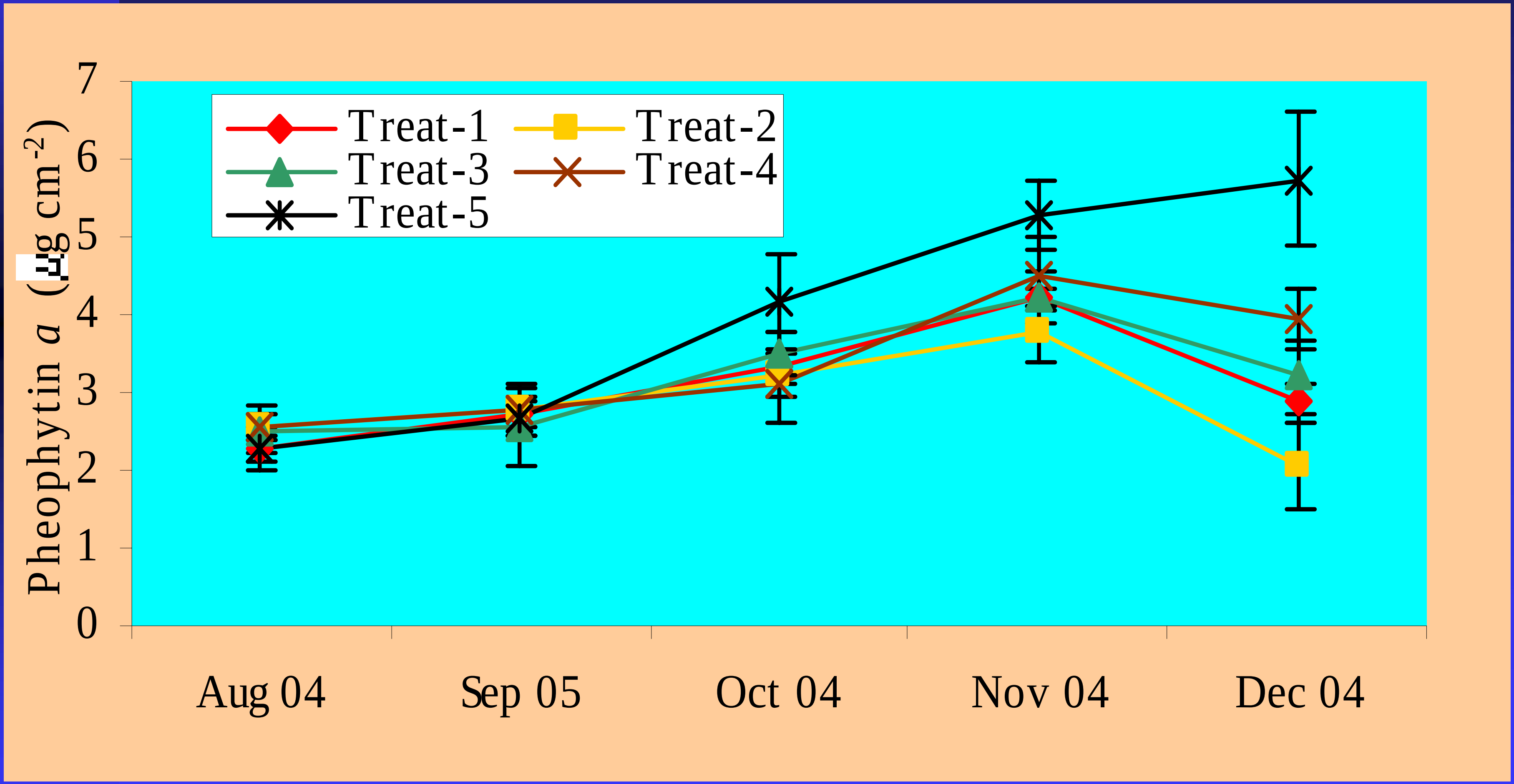
means (±SD) of periphyton dry matter per unit surface area of substrate



means (±SD) of Chlorophyll *a* concentration in periphyton per unit surface area of substrate



means (±SD) of pheophytin *a* concentration in periphyton per unit surface area of substrate



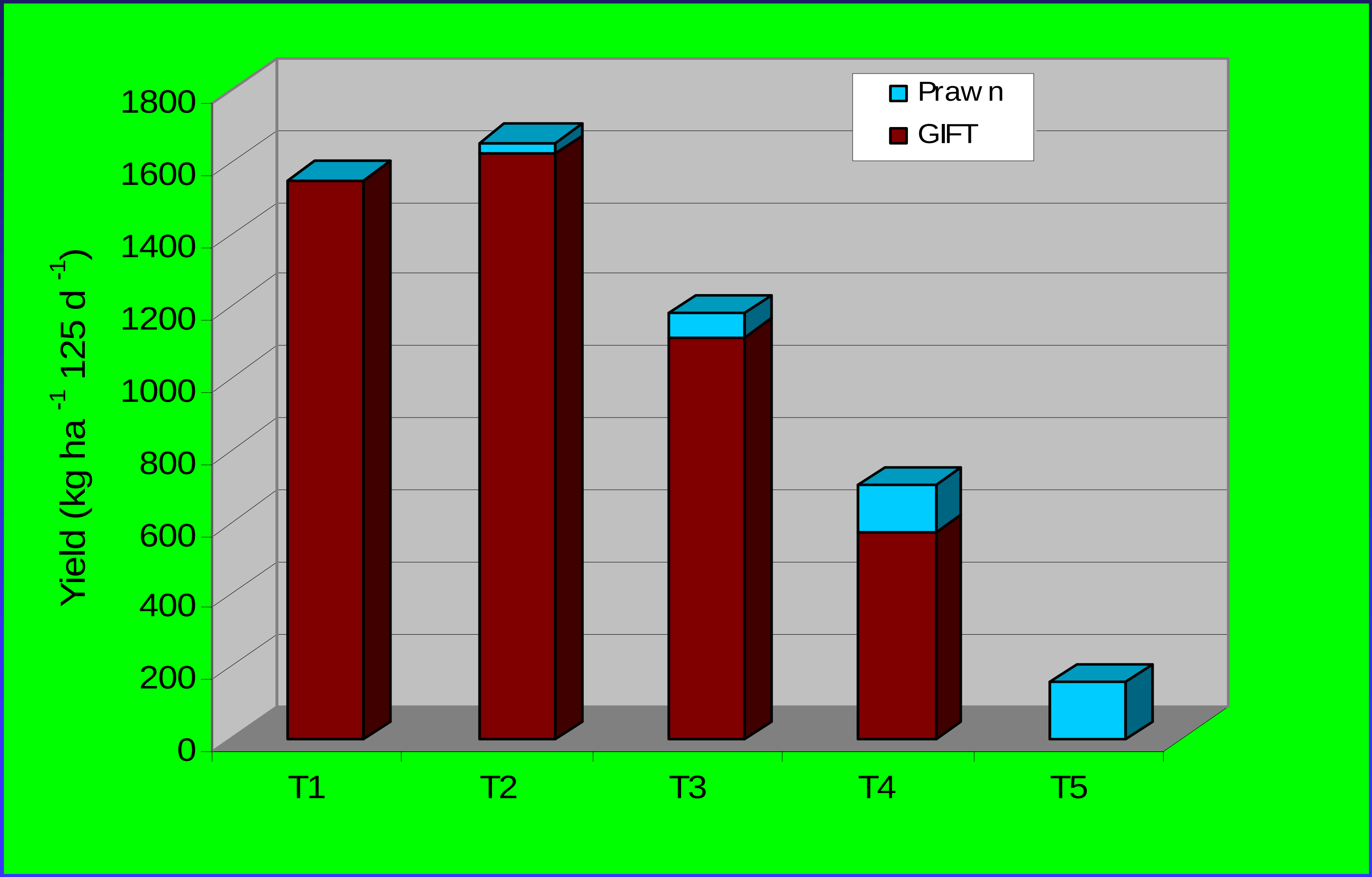
comparisons of means (±SD) of yield parameters of GIFT in different stocking ratios

Yield parameters	Treatments			
	T_1	T_2	T_3	T_4
Survival (%)	56.99^{b} (0.64)	65.62^{a} (3.22)	64.64^{a} (4.20)	63.88^{a} (1.20)
Stocking Length (cm)	4.76 (0.63)	4.54 (0.52)	4.70 (0.57)	4.51 (0.42)
Harvesting length (cm)	19.01^{c} (0.82)	19.94^{b} (0.61)	20.20^{b} (1.02)	20.85^{a} (0.84)
Stocking Weight (g)	2.16 (0.86)	1.81 (0.69)	2.05 (0.78)	1.76 (0.53)
Harvesting weight (g)	135.95^{c} (19.09)	164.92^{b} (13.71)	172.66^{ab} (16.85)	179.67^{a} (22.90)
Individual weight gain (g)	133.79^{d} (2.7)	163.1^{c} (3.5)	170.6^{b} (3.56)	177.9^{a} (1.81)
SGR (% bw d^{-1})	3.32^{b} (0.17)	3.61^{a} (0.07)	3.55^{a} (0.16)	3.70^{a} (0.20)
Yield (kg ha^{-1}125 d^{-1})	1549.44^{b} (31.18)	1622.53^{a} (50.70)	1114.35^{c} (57.62)	574.07^{d} (12.56)

comparisons of means (±SD) of yield parameters of prawn in different stocking ratios

Yield parameters	Treatments			
	T_2	T_3	T_4	T_5
Survival (%)	28.38^{c} (2.99)	30.48^{c} (3.60)	39.83^{b} (1.23)	48.24^{a} (5.98)
Stocking length (cm)	1.09 (0.13)	1.08 (0.15)	1.08 (0.15)	1.07 (0.15)
Harvesting length (cm)	11.59 (2.49)	12.01 (3.34)	11.93 (2.97)	10.87 (1.95)
Stocking weight (g)	0.01 (0.005)	0.01 (0.005)	0.01 (0.005)	0.01 (0.005)
Harvesting weight (g)	19.36 (3.02)	22.16 (3.51)	21.59 (0.79)	16.42 (2.04)
Individual weight gain (g)	21.14^{a} (3.02)	22.14^{a} (3.52)	21.58^{a} (0.79)	16.41^{b} (2.04)
SGR (% bw d^{-1})	5.46^{a} (0.10)	5.50^{a} (0.12)	5.48^{a} (0.03)	5.28^{b} (0.09)
Yield (kg ha^{-1}125 d^{-1})	29.67^{d} (1.40)	68.19^{c} (17.10)	129.12^{b} (8.64)	156.87^{a} (10.55)

relative contribution of GIFT and freshwater prawn to the net yields in different treatments



conclusion

- Survival of GIFT was significantly higher in polyculture but that of prawn was significantly higher in monoculture
- Survival of prawn was not affected by their own stocking density, however individual weight gain was significantly lower at the highest density
- Individual weight gain of GIFT was significantly increased at lower stocking density
- The highest yield (1,653 kg ha^{-1}) was recorded in treatment 2 at the combination of 75% GIFT and 25% Prawn

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