GROWTH OF FRESHWATER PRAWN (*MACROBRACHIUM ROSENBERGII*) UNDER DIFFERENT ORGANIC FERTILIZATION REGIMES AND STOCKING DENSITIES

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Abstract

Two experiments were conduted to determine growth of fresh water prawn under different fertilization regimes. In the first experiment, seven brick lined earthen ponds measuring 5 x 11 x 1.8 m were used. Organic fertilzer was obtained from either 4, 8, or 12 ducks kept in 2x2x1 m cages fixed over each pond allowing litter to drop directly into the water through a wire bottom. Two ponds were assigned for each of the three treatments, and the seventh pond was used as a control. A ten cm sand layer was prepared to provide suitable environment for the prawns which were stocked at a rate of 500 individals/pond (9.09/m2). In the second experiment, eight earthen channels measuring 2x10x1.3 m were used in two replicates. Prawns were stocked at a rate of 50, 75, 100 and 125 individuals per channel. Fifty gramme dry chicken litter/ channel were added daily. Average individual prawn weight was 0.2 g, in the two experiments. Twenty percent of the water volume was replaced daily and the duration of the work was 84 days.

Icreasing the number of ducks per pond resulted in decreased average daily gain (ADG), specific growth rate (SGR %) and increasing prawn mortality. The the best rate was one duck /14 m2.

Higher dry matter (DM%), crude protein (CP%), fat (EE%), and energy content were obtained from ponds receiving droppings of 4 ducks (12.7 g litter/day/m2)

With the fixed rate of chicken litter, increasing stocking rate resulted in decreased ADG, SGR% and incrasing prawn mortality. The best result was obtained with 50 prawn/channel (2.5 prawn/m2).

INTRODUCTION

Feed cost is a major factor limiting intensive fish and prawn culture (Shang and Fujimura 1977, Roberts and Baurer 1978). Thus, for economic purposes, fish and prawn have bean raised on natural food whose abundance can be enhanced by organic fertilization .

Freshwater prawn (*Macrobrachium rosenbergii*) is known as benthophagic omnivore, its production depends on the food material produced in the pond (Ling and Costello 1976). Consequently, highly eutrophic ecosystem may provide a ready substitute for supplemental feed for prawn. Integration of prawn production into various fish polyculture systems has been attempted to solve the ecological imbalance in intensive prawn monoculture for higher and cheaper standing crop (Malecha *et al.* 1981). However, raising prawns in monoculture using manure, has not been widely tested. Moreover, freshwater prawn rearing ponds are not normally fertilized (Singholka *et al.* 1975) .

The present study aims to determine the feasibility of raising prawns in monoculture using different rates of organic fertilizers and varying stocking densities .

MATERIALS AND METHODS

Two experiments were carried out in June 1995 at the experimental fish farm (Abis), Faculty of Agriculture, Alexandria University, in order to determine growth performance of freshwater prawn (*Macrobrachium rosenbergii*) under different organic fertilization regimes and stocking densities .

In the fist experiment, seven brick lined earthen ponds measuring 5x11x1.8 m were used. Pond bottoms were provided with a 10 cm layer of sand to furnish suitable environment for the prawns. Water level was kept at 1.3 m. Two ponds were assigned for each of three treatments in which organic matter was obtained from either 4,8 or 12 ducks of 21 days age and 1170.5 g average weight. The seventh pond was used as a control. Ducks were kept in 2x2x 1 m cages with 2 cm mesh wire bottom fixed over the middle of each pond. Prawns were stocked at 500 individuals per pond (9.09 prawns/m2) with an avraege weight of 0.2 g. Twenty percent of pond water was replced daily and floating algae were removed. Ducks were fed once daily in the morning on an increasing amount of duck ration proprtional to their in-

creasing weight. Ingrediendts of the duck diet were composed of ground yellow corn (65%), soyabeen meal (19%), broiler concentrate (7%), wheat bran (5.5%), limestone (1%), bone meal (2%) and salt (0.5%). Drinking water for ducks were provided in special containers.

In the second experiment, eight earthen channels (2x10x1.3 m) were used in two replicates. Water level was kept at one meter. The organic matter source was dry chicken litter which was added at a daily rate of fifty gramme per channel. Prawns were stocked at the rates of 50, 75, 100 or 125 individuals/channel. Average prawn weight was 0.2 gramme. Water changing rate was 20% daily. Floating algae were removed periodically.

In the two experiments, prawns were weighed at the start and at the end of the experiment. Mortality rate was determined at the end of the experiment .

Water quality parameters were measured weekly at 8 am for dissolved oxygen (DO), ammonia (NH3), pH, nitrite (NO2) and nitrate (NO3) concentrations according to Boyd (1979).

About fifty freshwater prawns were killed at the beginning of the two experiments and kept frozen at-20^{o}C for chemical analysis. At the end of both experiments, all freshwater prawns were killed and frozen at-20^{o}C till chemical analysis. Prawn samples were homogenized with Ultra-Turray homogenizer and oven dried (60-80^{o}C for 48 h).

Chemical composition (crude protein (CP%), ether extract (EE%), crude fiber (CF%), ash (%), and moisture (%) of prawn whole body were determined according to (AOAC 1984). Gross energy content of the whole body was calculated from the mean values of heat content of protein, lipid and carbohydrate being 5.64, 9.44 and 4.11 Kcal/g dry matter, respectively (NRC 1993) .

Experimental results were statistically analyzed according to Snedecor and Cochran (1971) and multiple range method (Duncan 1955).

RESULTS AND DISCUSSION

Experiment 1

Data presented in Table 1, concerning the first experiment show the effect of

fertilization intensity on water quality. The pH values were in the normal range (6.5-9) for prawn culture (New and Singholka 1984), whereas, DO values decreased with increasing the duck numbers i.e. increasing amount of duck droppings in pond water. The ranges of DO, as measured in the morning in the surface water was clearly above the concentration recommended by Swingle (1969) for successful aquaculture except in ponds receiving litter from 12 ducks. It is assumed that DO level at the pond bottom was lower and sub-optimum for prawn growth. NH3 values reached their maximum (1.423 mg/l) in the highly fertilized ponds. The European Inl /and Fisheries Advisory Commission (1973) stated that values of 0.6 - 2.0 mg NH3 are toxic to channel cat fish for short term exposure. NH3 is more toxic when DO concentration is low (Merkens and Downing 1957), a situation which is encountered in ponds with 12 ducks. Nitrite (NO2) concentrations also were high in these ponds, however, maximum concentration of NO3 (0.02 mg/l) was lower than that in the control ponds (0.122 mg/l). Small post-larvae of freshwater prawn are more susceptible than several species of marine shrimp to nitrite and nitrate (Wickins 1976). Crawford and Allen (1977) had mentioned that NO2 concentration as low as 0.5 mg/l was toxic to certain coldwater species. New and Singholka (1982) suggested that hatchery intake water should not have levels of nitrite and nitrate higher than 0.1 ppm (NO2-N) and 20 ppm (NO3-N).

Table 1. Water quality parameters in ponds fertilized with fresh duck litter (Exp .1).

	Number of ducks per pond							
	0.0 ducks		4 ducks		8 ducks		12 ducks	
Item	Max*	Min**	Max	Min	Max	Min	Max	Min
PH	8.51	8.05	8.01	7.67	8.20	7.57	6.79	6.5
Do2 (mg/l)	8.17	7.25	7.34	5.47	5.91	4.98	3.722	2.05
NH3 (mg/l)	0.210	0.116	0.271	0.188	0.342	0.251	1.423	0.317
NO2 (mg/l)	0.142	0.053	0.124	0.024	0.121	0.021	0.729	0.016
NO3 (mg/l)	0.122	0.021	0.117	0.013	0.110	0.010	0.024	0.001

* Maximum
** Minimum

Table 2 summarizes the results of growth performance of prawn under different fertilization intensities. Average individual gain (13.05 g/prawn) after 84 days rearing period was significantly higher ($P<0.01$) in ponds receiving litter of 4 ducks. This weight is better than that obtained by Malecha *et al.* (1981). They reported an

average weight of 12.7g after 131 days rearing period in an effluent pond (receiving water flow from a swine manured pond), though stocking rate in the present study was about double their stocking rate (9.09 vs 4.6/m2). The lowest average gain (3.63g/prawn),ADG (43.21 mg/day) and SGR% (3.51) were obtained from unfertilized pond (control); a result which may be normal due to the absence of eutrophication.

Survival rate varied gereatly among different treatments (Table 2). The best survival rate (85%) was obtained from control ponds (unfertilized). Values of 79.5 and 49.3% were obtained from ponds receiving droppings from 4 and 8 ducks,respectively. These values are better than those reported by Malecha *et al.* (1981) in swine manured ponds. The maximum survival rate they obtained was 48.1%, and the lower value was 17.4% which was attributed to DO depletion. Death of prawns began after the 4th week. The entire stocked prawns died in ponds receiving duck droppings of 12 ducks during the 5th week. Evidence of the effect of the heavy fertilization may be elucidated by comparing the rate of manuring used by Malecha *et al.* (1981). Loading rate of pig manure that caused oxygen depletion in their work was 5.2 g dry manure/m2. In our study, calculated dry weight of duck faeces exceeded 38.4 g/day/m2 in ponds with 12 ducks.

Table 2. Growth performance and survival rate of prawns reared in ponds fertilized with duck litter (Exp. 1).

Treatment	OM *	Wi	Wf	Average gain (g)	ADG (mg/day)	SGR (%)	Survival No.pond)	rate%	Total production (g/m2)
Control	0.00	0.2	3.63 ±0.00bc	3.63 ±0.00bc	43.21 ±1.88c	03.51 ±1.25c	425	85 ±000a	29.6
4 ducks	12.7	0.2	13.25 ±0.78a	13.05 ±0.72a	155.36 ±2.48a	4.99 ±1.50a	397.5	79.5 ±1.01a	95.8
8 ducks	25.7	0.2	5.14 ±0.83b	4.94 ±0.1b	58.81 ±0.32b	3.86 ±1.31b	246.5	49.3 ±0.90b	23.0
12 ducks	38.4	0.2	---	---	---	---	---	---	---

a,b,c Means in the same column followed by the same superscripts are not significantly differrent (P>0.05)
* OM : Dry organic matter of duck litter
Wi = Initial body weight (g/prawn).
Wf= Final body weight (g/prawn)
1- ADG = Average daily gain (mg/day/prawn)
2- SGR% = Specific growth rate = 100 ($^{1}nwr-^{1}nw^{i}$) / time (days)

The highest total production (95.8 g/m2) was achieved with 4 ducks/pond providing the pond with 12.7 g/m2/day (in average) dry organic matter (calculated by subtracting the final duck weight from the total weight of feed offered throughout the experimental period). The inputs of manure applied in the present study has clearly increased the pond productivity in duck manured ponds. The low production in Malecha *et al.* (1981) study may be attributed to both lower manure input (5.2 g/m2/day of swine manure), and the low survival rate (17%) compared to 79.5% in our study. In addition, the ponds received duck litter from 4 ducks did not suffer DO depletion problems. Lin and Boonyaratpalin (1988) reported 130 g/m2 with 30% protein formulated diet.

Table 3 shows significantly higer dry matter, protein, fat and energy content in prawns harvested from ponds receiving litter from four ducks. Data obtained were 27.52, 58.8, 6.6% and 450 kcal for these parameters, respectively. On the other hand, ash content (%) was significantly ($P<0.05$) higher in the prawns from control ponds.

Considering feed cost, a production as high as what we obtained using duck droppings was achieved.

Table 3. Chemical composition (on dry matter basis) of whole body of prawns (Exp.1).

Item	DM %1	CP %2	EE %3	Ash %	DM %1	EC5
Initial	23.53 ±0.02d	52.16 ±0.02d	4.48±0.1e	23.53 ±0.2a	19.83 ±0.2a	418 ±0.0e
Control	25.38 ±0.02 e	53.13 ±0.01 e	5.05±0.1a	23.21 ±0.01a	18.63 ±0.0b	433 ±0.0abc
4 ducks	27.52 ±0.02a	58.80 ±0.01a	6.60±0.0a	20.79 ±0.01b	13.82 ±0.0e	450±0.05a
8 ducks	25.82 ±0.04 b	55.77 ±0.03 b	5.39±0.0b	19.87 ±0.0e	18.98 ±0.1ab	443.5±0.5ab
12 ducks	---	---	---	---	---	---

a,b,c Means in the same column followed by the same superscripts are not significantly differrent ($P>0.05$)
1- DM = Dry Matter (%)
2- CP = Crude Protein (%)
3- EE = Ether Extract (%)
4- NFE = Nitrogen Free Extract (%)
5- EC = Energy Content (Kcal/100 g).

Experiment 2

Lower stocking density (2.5 prawns/m2) gave relatively the highest growth performance which is in agreement with that reported by Malecha *et al.* (1981). Average individual gain values throughout the experimental period (84 days) were 8.75, 6.82, 5.94 and 4.94 g with 50, 75, 100 and 125 prawns / channel (2.50, 3.75, 5.00 and 6.25 prawns / m2, respectively) (Table 4).

Table 4. Growth performance and survival rate of prawns stocked at different rates (Exp. 2).

Stocking Density No./channel	No./m2	Wi	Wf	Average gain (g)	ADG (mg/day)	SGR (%)	Survival No.pond	%	Total prod (g/m2)
50	2.50	0.2	8.95 ±0.2a	8.75 ±0.2a	104.17 ±0.0a	4.53 ±0.0a	50	100 ±00a	22.4
75	3.75	0.2	7.02 ±0.1b	6.82 ±0.1b	81.19 ±0.0b	4.24 ±0.0b	72	96.0 ±1.4a	25.3
100	5.00	0.2	6.14 ±0.1b	5.94 ±0.1b	70.72 ±0.0b	4.08 ±0.1b	7.5	7.5 ±0.5b	2.3
125	6.25	0.2	5.14 ±0.2c	4.94 ±0.2c	58.81 ±0.0c	3.86 ±0.1c	8	6.4 ±1.1b	2.0

a,b,c Means in the same column followed by the same superscripts are not significantly differrent (P>0.05)
Wi = Initial body weight (g/prawn).
Wf= Final body weight (g/prawn)
1- ADG = Average daily gain (mg/day/prawn)
2- SGR% = Specific growth rate = 100 (^{1}nwr-^{1}nw^{i}) / time (days)

Similar trend for decreasing survival rate was observed in connection with higher stocking rate. Reported survival rates in channels fertilized with chicken mannure were 100, 96, 7.5 and 6.4% for channels stocked with 50, 75, 100 and 125 prawn, respectively. Statistical analysis showed highly significant differences (P<0.01) between 50 and 75 / prawn/channel from one side, and 100 and 125/ prawn/channel from the other side. Low survival rates of prawns may be due to the high stocking rates 5/m2, though, these rates were relatively lower than those used by Malecha *et al.* (1981) (8.3/m2) in swine manured ponds. Pauel (1985) suggested that, at prawn densities ranging from 2500-5000 prawns/ha (0.25-0.5 prawn/m2) with grow-out periods of 107-153 days and generally no food supplements, prawn yields should range between 120 and 200 kg/ha. (12-20 g/m2).

As for prawns reared under daily application of fixed amount of chicken droppings with different stocking densities, protein percentage was lower with increasing stocking density, reflecting competition on the availabe feed. Values were 57.54, 56.24, 54.78 and 53.83% for 50,75,100 and 125 prawns/channel, respectively. Similar trend was observed for ash and dry matter content (Table 5).

Table 5. Chemical composition (on dry matter basis) of whole body of prawns reared at different densities (Exp .2).

Stocking rate prawn/channel	DM %1	CP %2	EE %3	Ash %	NFE %4	EC5
50	26.47 ±0.1a	57.54 ±0.01a	5.63 ±0.1ab	20.56 ±0.0a	16.28 ±0.2d	444.5 ±0.5a
75	26.28 ±0.0a	56.24 ±0.4b	5.38 ±0.b	20.48 ±0.4a	17.91 ±0.0c	441.5 ±2.5b
100	25.29 ±0.01b	54.78 ±0.1c	5.81 ±0.0a	19.70 ±0.1ab	19.72 ±0.0b	445.0 ±0.0a
125	25.18 ±0.0b	53.83 ±0.01a	5.41 ±0.0b	18.69 ±0.0b	22.08 ±0.0a	445.0 ±0.0a

a,b,c Means in the same column followed by the same superscripts are not significantly differrent (P>0.05)
1- DM = Dry Matter (%)
2- CP = Crude Protein (%)
3- EE = Ether Extract (%)
4- NFE = Nitrogen Free Extract (%)
5- EC = Energy Content (Kcal/100 g).

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تقدير نمو جمبري المياه العذبة *Macrobrachium rosenbergii* تحت نظم تسميد وكثافات تخزين مختلفة

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أجريت تجربتان لتقدير نمو جمبري المياة العذبة تحت نظم تسميد وكثافات مختلفة. في التجربة الاولي : استخدمت سبعة أحواض ترابية مبطنة بالطوب مقاسها ٥ x ١١ x ١,٨ وكان مصدر السماد العضوي إما ٤ أو ٨ أو ١٢ بطة موضوعة في أقفاص ٢ x ٢ x ١ متر مثبته فوق كل حوض بحيث تسمح لزرق البط بالسقوط مباشرة في الماء خلال أرضية من السلك . خصص حوضان لكل معاملة والحوض السابع استخدم كمعاملة قياسية . جهزت الاحواض بعشرة سنتميترات من الرمل لتوفير بيئة مناسبة للجمبري الذي خزن بمدل ٥٠٠ وحدة / حوض.

في التجربة الثانية : تم أستخدام ثماني قنوات ترابية مقاس ٢x١٠x١,٣ متر في مكررتين وخزن الجمبري بمعدل ٥٠ أو ٧٥ أو ١٠٠ أو ١٢٥ وحدة لكل قناة وأضيف ٥٠ جرام زرق دواجن جاف / قناه / يوميا. كان متوسط وزن وحدة الجمبري ٠,٢ جرام في التجربتين . وكان معدل تغيير المياة ٢٠٪ يوميا واستمرت التجربتان ٨٤ يوماً.

نتج عن زيادة عدد البط في الحوض نقص في النمو وزيادة وفيات الجمبري وكان أفضل معدل هو بطة واحدة / ١٤ متر مربع.

حصلنا علي أعلي نسبة من المادة الجافة والبروتين والدهن ومحتوي الطاقة في جسم الجمبري من الاحواض التي تلقت زرق (٤) بطات (١٢,٧ جرام / يوم/م٢).

وفي حالة المعدل الثابت من زرق الدواجن ترتب علي زيادة معدل التخزين زيادة معدل وفيات الجمبري وكانت أفضل نتائج النمو والاعاشة ومكونات الجسم عند وجود ٥٠ وحدة جمبري / قناه (٢,٥ وحدة لكل م٢)