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Environmental parameters and incidence of white spot disease in *Penaeus monodon* (Fab.) farming

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Abstract

An investigation was carried out to monitor management practices and to find out whether there is any relationship with occurrence of deadly white spot disease and environmental parameters. Three semi-intensive and a improved traditional shrimp farms were selected in which mass mortality of shrimp (*Penaeus monodon*) by white spot disease occurred previously. The farms were situated at two different geographical locations. Two ponds from each farm at random were selected for the study. Out of eight investigated ponds, 6 ponds in three farms were affected by the disease during investigation period. The non-affected ponds had relatively lower stocking density, slightly different management practice and were located at different geographical area. There were no significant variation in water quality parameters among the affected and non-affected ponds. No significant variations were recorded in pond preparation, source of Post Larvae (PL), water and feed management among the affected and non-affected ponds. The observation indicated that pond micro-organisms in a farm may not the only cause of the disease but some external factors also might be responsible for the outbreak of this disease.

Key words : *P. monodon*, Disease, Environment

Introduction

Brackishwater shrimp culture in Bangladesh is export oriented and developed in an unplanned and unregulated ways which mostly depends on repeated single species culture on the same soil. It also depend on the natural seeds of variable qualities and reclamation of culture lands through distribution of mangroves (Hossain 1995). Indiscriminate exploitation of natural post larvae together with destruction of the marine life through harvesting and handling process of post larvae and destruction of delicate

mangrove ecosystem, created an environmental situation, the effect of which was already started to some extent in the recent years. Modern aquaculture requires maximum out put of fish/shrimp per unit area. Over feeding, over crowding lead to malpractice's of the aquatic environment and ultimately caused diasters to shrimp farming (Hossain 1996).

During 1994-95, most of the semi-intensive shrimp farms were affected by the white spot disease. The out break of disease occurred during early stage of culture. It is usual phenomenon that aquatic disease is generally caused by the degradation of environmental and ecological condition as well as faulty management practices with the interaction of pathogens. In this study attempts were taken to find out whether water quality parameters were responsible for the out break of the white spot in shrimp farming or not.

Materials and methods

Three semi-intensive and an improved traditional shrimp farms were selected for this investigation during winter crop in which mass mortality of shrimp (*Penaeus monodon*) caused by white spot disease. From each farm two grow out ponds were selected for the study. The area of these ponds in selected farms were as follows: Beximco Fisheries Ltd. (5800m^2, 8400m^2), Meghna Shrimp Culture Ltd. (6000m^2, 5920m^2), Aquaculture Farms Ltd. (5464m^2, 3926m^2), Demonstration Farm and Training Centre (DFTC), FRI (3368m^2, 4940m^2). First three farms located in Khuruskul, Cox's Bazar area on the bank of the river Bakhkhali and the other farm at Teknaf area by the side of Naf river. Water depth in all investigated ponds ranged between 1.0-2.4 meters. Ponds were rectangular in shape except one at DFTC, FRI pond, the shape of the pond was irregular. Ponds had leading slope to the outlet. All farms had water intake and discharge facility, small laboratory, electricity, paddle wheel and pump facilities. Reservoir facility is available in all farms except DFTC, FRI.

From pond preparation to harvest, all management practice were observed carefully. Drying, pond preparation, stocking particulars are shown in Table 1. Water intake in each pond were done through screening by either micro mesh or mosquito nets to avoid the entrance of eggs, larvae or juveniles of undesirable species. The water in each pond was allowed to remain 3-4 days for hatching of eggs that might have accidentally entered into the ponds. Then tea seed cake was applied to eradicate the unwanted species of fin fish except Aquaculture and DFTC, FRI farm. Then ponds were fertilized and waited till plankton bloom (Table 1). Then Post larvae(PL) stocked which were collect from natural source.

Table 1. Pond preparation and stocking particulars in the investigated farms

Farms	Beximco		Meghna		Aquaculture		DFTC,FRI	
	Pond-1	Pond-2	Pond-1	Pond-2	Pond-1	Pond-2	Pond-1	Pond-2
Black soil removal*	partial	partial	partial	partial	partial	partial	Nil	Nil
Drying (d)	7	7	3	4	5	5	12	10
Liming $CaCO_3$ (kg/ha)	600	600	600	600	370	370	250	250
Water intake	24.7.95	24.7.95	30.8.95	30.8.95	9.8.95	9.8.95	3.9.95	12.9.95
Aerator	8	8	8	8	6	6	0	0
HP	12	16	16	16	12	12	0	0
Tea seed cake (ppm)	12	12	14	10	Nil	Nil	Nil	Nil
U+TSP+Pot kg/ha	5+10+0	5+10+0	13+13	13+13	Nil	Nil	Nil	Nil
Stocking PL/m^2	25	23.4	15	15	17.8	18	3.6	4.5
PL size (mm)	12-18	12-18	20-25	20-25	20-25	20-25	15-20	15-20

** Black soil was removed by mixing with water and discharged through out-let to the river.*

All farms used dry commercial formulated pelleted feed in addition to natural live foods produced in the pond. Feeding started at the second day of stocking except at DFTC, FRI. They started using feed after one month of stocking due to low stocking density, higher water depth and availability of natural food. Feed was spread at all front sides of the pond adjacent to the dikes. After one month of PL stocking, feed was checked from time to time by using lift nets to control under or over feeding.

All farms tried to maintain optimum water quality by applying lime(Calcium carbonate) and fertilizer as well as through water exchange. During high tide water was allowed to enter directly to the reservoir or into the feeder canal through main sluice gate and axial pump. Stored water was

treated with lime ($CaCO_3$) and settled, except at DFTC, FRI farm. Throughout the culture period Water temperature measured by centigrade thermometer, salinity by refractometer, transparency by secchi disk, pH by pH meter on daily basis and alkalinity, ammonia at weekly basis and dissolved oxygen (DO) at an irregular basis by Hach Kit. Paddle wheels were operated whole day and night except during feeding time.

Shrimp in each selected pond of all investigated farms were weighed weekly to monitor their average growth. For the purpose, 50 or 100 shrimps were harvested at random and weighed and released to the same pond. During sampling shrimps were closely observed to examine their gills, eye, intestine, antennae, appendages etc. Occurrence of disease was also recorded where it occurred.

Results and discussion

In the present study the highest salinity ranged between 16-24 ppt and lowest between 4-17 (Table 2) in all investigated farms. In all farms salinity increased gradually as culture period progressed. Lowest salinity at DFTC,FRI was very severe (4 ppt) during stocking. This was due to Naf river which carries vast amount of water from hilly areas of Bangladesh and Mayanmer and salinity turned at zero level annually during June-august period. However 4 ppt salinity was retained by not exchanging water during rainy season. Salinity increased when culture progress and rain fall stopped.

Table 2. Water quality parameters of selected ponds in four semi-intensive farms

	Daily basis							
Farms	Beximco		Meghna		Aquaculture		DFTC,FRI	
	Pond-1	Pond-2	Pond-1	Pond-2	Pond-1	Pond-2	Pond-1	Pond-2
Salinity (ppt)								
Highest	18	18	21	21	24	24	16	16
Lowest	11.5	11	16	15	12	13	4	4
Temp. (°C)								
Highest	34.0	34.0	32	32	34	34	34	34
Lowest	27	27.0	25	26	25	25	25	25
pH								
Highest	8.9	8.8	8.5	8.8	8.8	8.9	8.3	8.2
Lowest	7.5	7.5	7.5	7.6	7.7	7.9	7.3	7.3
Transparency (cm)								
Highest	80	75	90	90	65	65	95	97
Lowest	34	26	28	22	34	25	29	30

	Weekly basis							
DO(ppm)								
Highest	9.5	9.0	9.5	9.5	9.0	9.5	7.5	7.5
Lowest	5.0	5.0	5.0	5.5	4.5	4.0	3.5	3.5
Ammonia(ppm)								
Highest	0.3	0.4	0.3	0.2	0.4	0.4	0.5	0.5
Lowest	trace	trace	trace	trace	trace	trace	0.1	trace
Alkalinity (ppm)								
Highest	114	120	120	138	111	99	84	87
Lowest	89	76	81	78	87	90	60	51

The highest temperature in all investigated farms were ranged between 32 -34°c and lowest were recorded in between 25-27°c (Table 2). pH level was almost similar in all investigated farms where the highest range was 8.2-8.9 and the lowest was 7.3-7.9. The highest transparency in all investigated farms ranged between 65-97 cm and the lowest 22-34 cm. transparency were relatively higher at early stage and gradually decreased as culture period progressed. This due to the fact that, with the advancement of culture period, organic deposition increased at pond bottom which leads to an increase in plankton production. Highest range of DO in all investigated farms varied from 7.5-9.5 ppm and the lowest range was 3.5-5.5 ppm (Table 2). Ammonia was variable in all investigated farms and ranged from trace to 0.5 ppm. Highest alkalinity range was 84-138 ppm and the lowest was 51-90 ppm in all the farms. pH, alkalinity, DO, ammonia were recorded to decrease gradually which might be due to increased biomass in the investigated ponds. However, the recorded water quality parameters could be considered as suitable for the culture of *P. monodon*. Similar diversion were also recorded by Larkins (1995), except for salinity at DFTC,FRI farm. Kibria (1985) and Islam (1983) were at the opinion that routine checking of pond conditions are necessary for physico-chemical parameters and the authors further mentioned that optimum range of temperature, pH, DO and salinity were 28-33°C, 8-9, 8-9ppm and 15-25 ppt respectively. Chanratchakool *et al.* (1995) mentioned the optimum range of pH, salinity as 7.5-8.5 and 10-30 ppt respectively.

Three of four investigated farms were affected by disease which situated in same area and disease outbreak occurred during 2nd half of September to 1st half of November at the age of shrimp was 51-78 day (Table 3). Disease may be transmit from one farm to another by water through carrier. Three affected farm drained out water to river after disease out break. All farm use

similar fry which were collected from nature but one farm harvested disease free shrimp which indicated that fry may not responsible for the disease. Disease outbreak occurred during September to November when weather terns dry and cool which may create stress condition on shrimp. In Teknaf region temperature remained relatively higher than Cox's Bazar.

Table 3. Sign or out-break of disease in investigated ponds of different farms

Farms	Beximco		Meghna		Aquaculture		DFTC,FRI	
	Pond-1	Pond-2	Pond-1	Pond-2	Pond-1	Pond-2	Pond-1	Pond-2
1st Disease detected	(22.9.95)	(22.9.95)	(27.10.95)	(30.10.95)	(10.11.95)	(10.11.95)	No	No
Out break on culture day	58	57	48	51	78	77	No	No
Average body wt(g) when disease outbreak	8.1	8.5	13.3	8.2	17.7	15.7	*9.9	*12.3
Harvest on culture day	67	66	78	80	81	79	75	75
% Survival	48.6	30	41.7	62.7	34.1	31.6	52.5	47.73

** When shrimp harvest with out disease.*

Total feed used, production of shrimp and FCR for each pond as a whole in all investigated farms had considerable variations. This is due to variable stocking date, time of disease outbreak, percent of survival and size of the shrimp. Growth of shrimp in all the farms were more or less at a satisfactory level before incidence of disease out break.

The average weight of shrimp were 8.1 and 8.5 g, 13.3 and 8.2 g, 17.7 and 15.7 g, 9.9 and 12.3 g in pond no. 1 and 2 of Beximco, Meghna, Aquaculture and DFTC,FRI farms respectively on the day of disease outbreak/harvest (Table 3). Here it may be mentioned that through the shrimp at DFTC,FRI was not affected by the disease, but it was harvested due to winter.

The recorded Food Conversion Ratio(FCR) were 1.51 and 1.67, 1.03 and 1.02, 1.13 and 1.52, 1.52 and 1.43 in pond no. 1 and 2 of Beximco, Meghna, Aquaculture and DFTC,FRI farms respectively on the day of harvest (Table 4). The average production were 791, 860, 989, 360 kg/ha of Beximco, Meghna, Aquaculture and DFTC,FRI farm respectively.

Table 4. Production and apparent feed efficiency in investigated ponds during culture period

Farms	Beximco		Meghna		Aquaculture		DFTC,FRI	
	Pond-1	Pond-2	Pond-1	Pond-2	Pond-1	Pond-2	Pond-1	Pond-2
Source of feed	President	President	CP	CP	SBFFL	SBFFL	SBFFL	SBFFL
Total Feed (Kg)	865	835	610	445	666	540	160	290
Production (Kg)	571	502	590	437	587	355	105	203
FCR	1.51	1.67	1.03	1.02	1.13	1.52	1.52	1.43
Production /ha (kg)	984	598	983	738	989	904	311	410

SBFFL = Saudi Bangla Fish Feed Ltd. (Bangladesh).
CP = Charoen Pokphand Feed (Thailand).
President = President Feed (Taiwan).

However, a highest production of 989 kg/ha was obtained by Aquaculture farm due to the fact that the farm had a longer culture of 81 days. Chowdhury *et al.* (1991) obtained 1815 kg/ha with in a 126 day culture period in the same farm with out disease. However in the present experiment, DFTC, FRI farm had a period of 75 days and culture had to terminate due to winter season with lower production of 360 kg/ha. This is due to a lower stocking density of 4 pc/m^2. Further, it may be mentioned that DFTC,FRI ponds were under a project to look after environment friendly semi-intensive shrimp farming and deliberately maintained lower density to find out sustainability of shrimp farming.

The present study is a preliminary one to find out whether water quality parameters are responsible for the outbreak of disease or not. There is no significant variation in water quality parameters among the affected and non affected ponds. As Bangladesh earns a significant amount of foreign exchange by exporting shrimp, due attention should be given to control this shrimp disease. However, emphasis should be given to carry out more research work to improve disease free shrimp farming and to make it a sustainable venture suitable to socio-geographical and climatic conditions of Bangladesh.

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