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Effect of Vibrio Bacterial Product CIBASTIM Administration on Productivity in Commercial Tiger Shrimp *Penaeus monodon* Culture Ponds in Gujarat

HARESH G. SOLANKI[1], JAIMIN H. BHATT[1], C. GOPAL[2], PRASANNA K. PATIL[2], and S. M. PILLAI[2]

[1]*Soil and Water Management Research Unit, Navsari Agricultural University, Navsari, Gujarat, India*

[2]*Central Institute of Brackishwater Aquaculture, Chennai, Tamil Nadu, India*

A study was conducted to evaluate the effect of an immunostimulant product prepared from vibrio bacterial components on production of Penaeus monodon *culture in five commercial shrimp farmer's ponds in the Navsari district of Gujarat. The product was administered at the concentration of 2 × 10^8 cfu/kg pelleted feed as top dressing using a commercial binder for two consecutive days in a week. In general, we observed improvement of up to 33.33% in average body weight, up to 44.83% in survival rate, up to 11.11% in FCR, and up to 50.00% in production per ha over untreated control ponds on the same farm. Administration of this vibrio bacterial product could improve shrimp production in Gujarat.*

KEYWORDS Bacterial product, immunostimulant, tiger shrimp, vibrio

INTRODUCTION

Shrimp culture in ponds has been one of the major sources of income for the livelihood of coastal farmers in India (Ponnusamy et al. 2010). Production has been fluctuating due largely to white spot disease outbreaks since 1993–1994. Many preventive measures such as crop holiday, adoption of better management practices, etc., have not controlled frequent disease outbreaks. Use of

Address correspondence to Haresh G. Solanki, Soil and Water Management Research Unit, Navsari Agricultural University, Navsari, Gujarat 396450, India. E-mail: hgsolanki@gmail.com

antibiotics in shrimp aquaculture has been banned (see Karunasagar et al. (1994); Moriarty (1998); and Srinivasan and Ramasamy (2009). Recently, dietary supplementation with immunostimulants in the form of probiotic bacteria has been used as an alternative to antibiotics (Farzanfar 2006; Smith et al. 2003). These include a wide range of live and dead bacterial preparations, glucans, peptidoglycans, and lipopolysaccharides (LPS) to stimulate the immune system of shrimp (Lightner 1983).

Improved growth and survival of shrimp receiving vibrio bacterin have been reported (Sung et al. 1991; Devaraja et al. 1998; Teunissen et al. 1998; Klannukarn et al. 2004; Azad et al. 2005). A safe and easy-to-apply immunostimulant based on formalin-inactivated whole-cell vibrio bacteria developed by the Central Institute of Brackishwater Aquaculture (CIBA) in Tamil Nadu, India, was tested in different geographical areas and found to improve growth, survival, and condition of the pond-bottom environment. This article reports results of a series of field trials conducted in commercial shrimp culture operations in the Indian state of Gujarat. The study was carried out under a collaborative project between CIBA and the Navsari Agricultural University, Navsari, Gujarat.

MATERIALS AND METHODS

The study took place at five sites in four villages in Navsari and Dandi districts of Gujarat, India: Danti (two sites), Onjal, Samapur, and Bucharwada. Interested shrimp farmers from these areas were selected based on their previous shrimp culture experience and their expression of interest. From each farm, two ponds were randomly adopted for demonstration trails: one control and one treatment. During the culture period, parameters related to water, soil, and shrimp health were regularly monitored.

A total of ten ponds (five treatment and five control) ranging from 0.5 to 1.0 ha were chosen for Central Institute of Brackishwater Aquaculture Stimulant (CIBASTIM) demonstration trails. Pond soils were clay loam. Tidal sea water from a nearby creek was pumped through a series of filtration systems into reservoir ponds and, after settling for 2 d, commercial bleaching powder (available chlorine 30%) was applied at the rate of 350–400 kg/ha depending upon the farmer's discretion. After 3 d, lime was applied at the rate of 100 kg/ha. Ponds were subsequently fertilized with a fermented juice comprised of 5 kg rice bran, 5 kg unrefined sugar (known locally as "jaggery") and 100 g yeast and 100 liters of sea water per ha. This generates a light green algal bloom in 10–15 d, which is maintained until harvest through regular application of the fermented juice. Water level in the pond was maintained around 1.2 to 1.4 m. Water seepage and evaporation were compensated by pumping pretreated water from reservoirs. Long-arm paddle-wheel aerators were provided in each pond.

TABLE 1 Salinity range of demonstration sites.

Particulars	Site 1	Site 2	Site 3	Site 4	Site 5
Location (village)	Danti	Danti	Bucharwada	Onjal	Samapur
Stocking time	15 June	15 June	5 June	25 May	5 June
Days to market size	142	145	130	145	179
Salinity at stocking	48	48	33	35	48
Salinity at harvest	15	15	25	12	15

P. monodon postlarvae (PL 15), procured from a commercial hatchery were released into the ponds after proper acclimatization. Stocking density ranged from five to eight shrimp/m2, which is as per Costal Aquaculture Authority (CAA) guidelines. Immediately after stocking, shrimp were fed a commercial starter diet twice a day as per the standard feeding chart of the feed manufacturer. The immunostimulant (containing dead vibrio bacterial cells) was administered at a concentration of 2×10^8 cfu/kg feed as top dressing using a commercial binder for two consecutive days per week throughout the culture period from the day of stocking to harvest. In each farm, equal number of ponds was kept as control without administering the immunostimulant, and uniform management practices were followed in all the treated and untreated ponds. Health of the animals and feed intake was monitored through four check trays installed in the pond. Blind feeding was done for the first 35 d, and thereafter feeding was adjusted based on sampling. Fortnightly, cast net sampling was carried out to assess growth and health conditions of cultured animals throughout the culture period. Average body weight gain (ABW) and average daily growth (ADG) were calculated on the basis of the sampling data.

The date of stocking varied among sites (Table 1). Sites 1, 2, and 4 were stocked in mid-June. In these ponds, the monsoons effectively lowered salinity to 5 ppt, as the minimum. Sites 3 and 5 were stocked the first week of June when salinity was 33 and 48 ppt, respectively. Since exchange of water at site 5 was difficult, the salinity was >35 ppt for 40 days after stocking.

RESULTS AND DISCUSSION

We observed a 3.57% to 33.33% improvement in average body weight (g) of shrimp fed the immunostimulant compared to the control (without immunostimulant), except at Site 1, where the effect was marginally negative (Table 2). This could be explained if the mortality observed in the control pond at Site 1 occurred very early in the production cycle, effectively lowering the stocking density. On all farms, total production (kg/ha) was between 7.01% to 50% better in the treatment, compared to the control pond, even at Site 1 (16.67% improvement over control).

TABLE 2 Production details of shrimp farm ponds fed 2 days per week with and without immunostimulant.

	Site 1			Site 2			Site 3			Site 4			Site 5		
	T	C	Δ (%)	T	C	Δ (%)	T	C	Δ (%)	T	C	Δ (%)	T	C	Δ (%)
Pond surface (ha)	0.5	0.5		0.9	0.9		0.8	0.8		1.0	1.0		0.88	0.89	
Culture period (d)	145	147		145	145		150	150		131	132		160	160	**15.39**
Number stocked	35,000	35,000		50,000	50,000		40,000	40,000		66,000	66,000		40,000	40,000	
Stocking density (per m^2)	7	7		5.6	5.6		5	5		6.6	6.6		8	8	
ABW (g)	33.33	37.04	**−10.00**	33.3	25	**33.33**	35.71	34.48	**3.57**	41.49	35.71	**16.18**	38.46	33.33	**15.39**
Size (Pcs/kg)	30	27	11.11	30	40		28	29		24.1	28		26	30	
ADG (%)	0.23	0.25		0.23	0.17		0.24	0.23		0.32	0.27	**17.07**	0.24	0.21	
Harvest biomass (kg)	1050	900	**16.67**	1250	840	**48.81**	1200	800	**50.00**	2169	2027	**7.01**	2222	1736	**28**
Total feed (kg)	1344	1296		1775	1428		1560	1120		2993	3162		3514	2604	
Survival (%)	90	69.4	**29.63**	75.0	67.2	**11.61**	84.0	58.0	**44.83**	79.0	86.0	**−8.14**	82.75	70.86	**16.78**
FCR	1.28	1.44	**11.11**	1.42	1.70	**16.47**	1.3	1.4	**7.14**	1.38	1.56	**11.54**	1.58	1.5	**−5.06**
Production (kg/ha)	2100	1800	**16.67**	1389	933	**48.81**	1500	1000	**50.00**	2169	2027	**7.01**	2525	1929	**30.89**

T = Treatment pond; C = control.

FCR in all ponds ranged from 1.3 to 1.6, within the range of values generally obtained in better-managed shrimp ponds (Saha et al. 1999; Paul Raj 1999; Mohanty 2001; Mahmood et al. 2005; Soundarapandian and Gunalan 2008; Soundarapandian et al. 2010; Pushparajan and Soundarapandian 2010). Treatment ponds featured modestly lower FCR compared to controls, except at Site 5, suggesting a role for immunostimulants in improving feed utilization and thus lowering production cost.

Our application of immunostimulant in feed on only two consecutive days per week was based on earlier trials with this product (Azad et al. 2002). Other studies with similar immunostimulant products too recommended weekly application, which seems to be maximally effective in reducing the cost of production of harvestable shrimp (Rohini et al. 2012).

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