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STUDIES ON REARING OF *PENAEUS MONODON FABRICIUS* IN BRACKISHWATER PONDS USING PELLETED FEEDS

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The results of field experiments on growth and survival of *Penaeus monodon* Fabricius using three compounded feeds are presented in this paper. The feeds termed I, (Using soyabean powder as the main ingredient), II (fish meal as main ingredient) and IV (squid meal as the main ingredient) were first tested in laboratory trials. These experiments gave conversion ratios of 2.4 : 1, 6.0 : 1 and 2 5 : 1 for feed I, II and IV respectively. Therefore, the trials were taken up in the field, in 0.02 ha brackishwater ponds at the Kakdwip Fish Farm of the Central Inland Fisheries Research Institute, Barrackpore using post-larvae of *Penaeus monodon* as the test animals. The prawns fed on feed IV showed maximum growth followed by feed I and II. The production, (shown as yield per ha /110 days) was 239.00 kg, 172.45 kg and 109.75 kg with the feed IV, I and II respectively.

In the recent decade, large scale farming of commercial species of prawns has been taken up in the Indo-Pacific region. Intensive prawn farming calls for, among other things, the provision of an adequate and inexpensive artificial diet which ensures faster growth and greater survival of the cultivable species. Several workers have formulated diets using a wide range of ingredients of animal and plant origin supplemented with micro ingredients like vitamins, minerals etc (Lee, 1971 : Andrews *et al.*, 1972 : Deshimaru and Shigueno, 1972 : Balazs *et al.*, 1973 : Forster 1975 ; Venkataramaiah *et al.*, 1975 : Zein-Eldin and Corliss, 1976 : Rajyalakshmi, 1978, Rajyalakshmi *et al* , 1979). However, all these studies have been confined to laboratory trials only. Alikunhi *et al.*, (1975) have used a pelleted diet containing 20% of crude protein in pond rearing of *Penaeus monodon.*

In India, a major project on nutrition and feed formulation of cultivable species of prawns, particularly *Penaeus monodon* has been launched by the Central Inland Fisheries

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Research Institute, Barrackpore. The preliminary results of the laboratory experiments on growth & survival of post larvae and juveniles of *Penaeus monodon* using 6 formulated diets have beenpresented by the authors earlier (Rajyalakshmi *et al.*, 1979). The present study deals with the performance of three of the six pelleted diets used in laboratory trials. The test feeds have been tried in 0.02 ha brackiswater ponds at Kakdwip Fish Farm, West Bengal.

Meterials and Method

Three Brackishwater ponds each of 0.02 ha located at the Brackishwater Fish Farm (Kakdwip) of Central Inland Fisheries Research Institute, Barrackpore, West Bengal were prepared following the procedures used in pond management (Rajyalakshmi, 1980). The ponds were, at first, dewatered, raked and then levelled. Poultry manure @ 1,000 kg/ha was applied in each pond and then they were exposed to sun for three days. On the fourth day, about 10 cm of brackishwater was siphoned into the ponds. Care was taken as far as possible to check the entry of unwanted fishes, prawns and predators. Inorganic fertilizers viz , urea and superphosphate each @ 5,00 kg/ha were applied in the pond on the fifth day. On the seventh day, the ponds were refilled with brackishwather to a level of 90 cm. A minimum of 90 cm water was thereafter maintained in all ths ponds during the culture duration of 110 days.

Post larvae of *Penaeus monodon* were collected from the Muriganga estuary (a branch of the Hoogly estuary) using Midnapore type spawn collection (shooting) nets during spring tides. The post larvae so collected, were then conditioned in plastic pools using brackish-water pond water for 2 days. No supplementary feeding was done at this stage. The ponds (1, 2 and 3) were stocked with post-larvae (average size 13.2 mm/0.1 g) @ 35,000/ha. Several bundles of palm leaves were placed in the corners and at the marginal regions of culture ponds. These acted as substrata for the luxuriant growth of periphyton and 'Lab-Lab' and further they provided shelter to the growing prawns, especially to the newly moulted ones.

Three formulated diets I, II and IV were selected from six diets tested earlier in laboratory experiments using post larvae of *Penaeus monodon* as test animals. In the 3 diets the main source of protein was soyabean flour (Feed I), fish meal (Feed II) and squid meal (Feed IV). The three feeds were tried as supplementary feeds for *Penaeus monodon* in ponds 1, 2 and 3 respectively. The feed pellets were placed in plastic feeding trays fixed at the 4 corners of the pond. The process of pelletization has been described in an earlier paper (Rajyalakshmi *et al* , 1979).

In 110 days of rearing, supplementary feeding was practised for the first 70 days. only. The prawns were fed daily @ 50% of the total body weight for the first 30 days, 30% for the next 15 days and 10-3% for the remaining 25 days.

Manuring and fertilization of ponds were done once in a fortnight at the rates as specified above. Weekly sampling was conducted to study the fluctuations, if any, in

temperature, salinigy, pH and so on ; the plankton samples were taken fortnightly and the bottom biota was sampled once in a month. During spring tides the water in the ponds was exchanged by siphoning method. Weekly sampling was done with fine mesh rectangular dragnets/termed 'hapa to assess the survival and growth of prawns Harvesting was carried out by dewatering the ponds at the end of the culture period.

Table—1 Composition of the formulated feeds.

Ingredient	Feed I (g)	Feed II (g)	Feed IV (g)
Squid meal	—	—	60.0
Fish meal	—	44.4	—
Rice bran	—	—	20.0
Wheat powder	20.0	24.2	19.0
Maize powder	36.5	—	—
Soyabean powder	35 5	—	—
Ground nut oil cake	—	29.0	—
Brewer's yeast	5.0	0.2	0.2
Vitamin mix	1.0	1.2	0.2
Calcium phosphate	1.0	—	0.6
Sodium hexametaphosphate	—	1.0	—
Algin	1.0	—	—
* Conversion	2.4	6.0	2.5

Table—2 Proximate composition of pelleted feeds

Feed	% Moisture	% Protein *	% Fat *	% Carbo-hydrates *	% Ash*
I	10.5	24.2	2.4	66.4	7.0
II	7.9	28.9	6.2	36.1	20.8
IV	11.0	35.8	6.1	42.4	15.7

* Expressed on dry matter basis.

Results

The details of stocking, growth, survival and production of *Penaeus monodon* fed with diets I, II and IV are presented in Table 3.

Details of stocking, growth, production & survival of *Penaeus monodon*

Ponds	Cultue duration (days)	Feeds	Stocking density (no/ha)	* Av. initial sizes		* Av. final size		* Av. Growth per day		Production	
				Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)	(kg/ha 110 days	Sur. vival (%)
1	110	I	35,000	13.2	0.01	98.2	7.75	0.8	0.06	172.42	77.9
2	110	II	35,000	13.2	0.01	82.5	3.50	0.6	0.03	109.75	70.9
3	110	IV	35,000	13.2	0.01	132.3	19.50	1.2	0.18	239.0	35.9

* Expressed as the average measurement of 20 prawn.

In pond 1, where feed I was given, the prawns attained an average size of 98 2 mm/7.75g. They showed a daily growth of 0 8 mm/0.07 g In pond 2 where feed II was used, the prawns registered an average growth of 82.5 mm/3.5 g ; the daily growth increment was 0.6 mm/0 03 g. Prawns fed on feed IV (pond 3) showed the maximum growth of 132.3 mm/ 19.5 g and the daily growth increment was 1.1 mm/0 18 g. In 110 days of culture, an estimated production of 17.45 Kg/ha, 109.75 kg/ha and 239.0 kg/ha were obtained from ponds 1, 2 and 3 respectively. (The total production including that of miscellaneous prawns and fishes being 330 95 kg/ha in pond 209.75 kg/ha in pond I and II and 355 75 kg/ha in pond 3. Despite all care, larval prawns and fish found access to the pond through crab tunnelings etc).

The growth pattern of *Penaeus monodon* during different sampling days is shown in Fig. 1. *Penaeus monodon* fed with feed I showed the highest survival of 77 9% with feed II

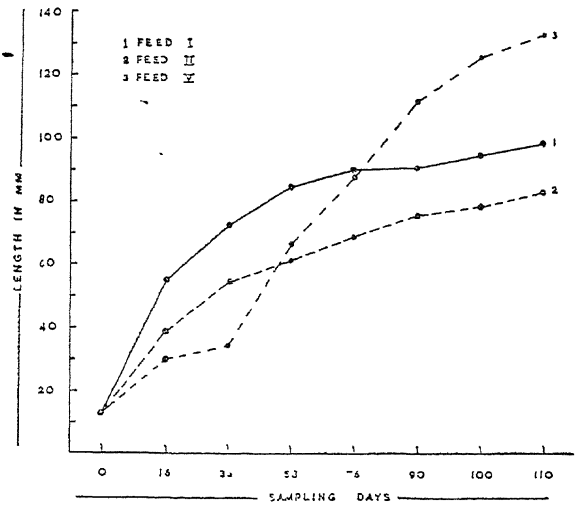

FIG 1 GROWTH OF P monodon FED WITH DIFFERENT FEEDS IN CULTURE PONDS

(70 9%) and IV (35.9%). It is interesting to note that better growth rate and production were obtained in pond where the survival rate was poor (Feed IV) than in the ponds where survival was high but production was lower (Feeds I & II)

Miscellaneous prawns such as *Palaemon Styliferus*, *Macrobrachium rude*, *Metapenaeus monoceros* and *M. brevicornis* and predatory fishes such as *Lates calcarifer*, *Eleutheronema tetradactylum* and *Therapon jarbua* accidently entered in to the culture ponds through internal tunnelings of pond bottom and lateral banks, despite constant management measures adopted to check their entry. They competed for food and space with the stocked species and in addition,

they fed directly on the prawns ; these factors could have partially accounted for the observed low survival and growth rate of *Penaeus monodon* in all the ponds.

The settled volume of plankton and also the concentration of zooplankton of ponds, 1 2 and 3 showed marked fluctuations *Diaptomus*, *Brachionus*, *Mysids*, *Gammarus* and nauplii larvae were encountered in bottom biota. The monthly variation in the hydrogrophical factors of the culture ponds are given in Table. 4.

Discussion

According to New (1976) food is normally the largest single item in the running expenditure of a shrimp farm. Hence, the suitability and cost effectiveness of the ration are of paramount importance to commercial success. The ingredients used for the formulation of the diets in the present study are normally available at inexpensive rates except for the soyabean, vitamin and algin. These items are used in low quantities only in feed formulation. However, the cost per kilogram of feeds I, II and IV worked out at Rs. 9.00, Rs. 5.40 and Rs. 3.30 respectively. For large scale farming the costs of feeds I, II and IV are rather prohibitive as per standards prevailing in India,

Among the three feeds tested, feed IV has imparted better growth compared to feeds I and II (Table 2 and 3). As mentioned earlier, although the culture was extended upto 110 days feeds were provided for the first 70 days only. Prawns fed on Feeds I and II showed reasonably steady growth upto 70 days (Table 3) and thereafter the rates of growth slowed considerably till the harvesting time. Contrary to this, in pond 3 where feed IV was provided, the prawns exhibited faster rate of growth throughout the culture period although in the first fortnight, immediately after stocking, the post-larvae were very slow in growth compared to those in ponds 1 and 2. In pond 3, the rate of growth slowed down slightly after 90 days of culture but to a lesser extent than in ponds 1 and 2. The growth rate was relatively faster when given artificial feed, specially after 36 days of culture (Fig. 1). Generally field conditions .do not permit replicates of even duplicate tests, because of variation in the physico chemical conditions etc. Different ponds react differently to the added supplemental feeds, which act as partial fertilizer also. Comparing growth rates under such limitations is untenable. However, in this study the feeds were tested under the laboratory conditions and then transferred to field. Similarities in the growth reaction between the lab and field trials are taken as a fair indication of the efficacy of the tests.

The general hydrological conditions are detailed in Table 4. The fluctuations from pond to pond and month to month are not wide. It must be reiterated that the brackishwater culture system being a partially controlled system, fluctuations are likely to be related to the water that is being taken from the tidal waters. Except to see that the temperature and salinity and dissolved oxygen have not declined below the ambient level prevailing in the estuary, no other control has been possible.

Table–4

Hydrographical parameters of the *Penaeus monodon* culture ponds

Hydrographical parameters	Pond 1				Pond 2				Pond 3			
	April	May	June	July	April	May	June	July	April	May	June	July
Temperature (oO)	32.2-34.6	33.2-35.0	29.8-34.0	32.6-34.0	32.6-34.8	32.8-34.8	29.5-33.8	32.4-32.8	32.6-35-0	33.4-34.8	29.8-34.0	32.8-34.0
Salinity (%)	16.63-18.44	16.63-18.80			14.63-15.91		13.74-18.00		15.19-15.91		14.83-18.08	
		16.63-18.80		10.13-13.38		15.9-17.35		8.33-12.66		15.19-16.63		10.36-13.38
DO (ppm)	7.6-9.6	6.8-10.0	8.4-12.8	8.4-9.6	7.6-8.8	7.6-13.6	7.6-10.0	8.9-9.0	7.6-9.6	7.6-10.0	7.6-10.0	7.6-10.0
Total alkalinity (ppm)	90-116	80-84	70-106	100-104	94-124	100-116	110-130	110-123	72-96	80-84	88-100	90-96
pH	8.6-9.0	9.0-9.2	8.2-9.6	8.8-9.0	8.6-8.8	8.4-8.6	8.4-8.6	8.4-8.8	8.4-9.2	9.0-9.2	8.0-9.6	8.0-9.6
Turbidity (mm)	130-210	145-170	170-180	190-220	190-220	195-210	200-210	220-240	150-210	180-190	170-230	180-200
Water depth (cm)	61-69	60-68	60-72	72-83	87-97	87-107	88-106	88-97	66-72	65-74	60-85	82-86

Survival on the other hand, in prawns, in general, is controlled by several factors of which feed is an important one. Under earlier studies (Rajyalakshmi, 1978) it has been observed that survival is inversely related to growth ; the greater the growth, the lower the survival, indicating cannibalism, territorial fights, and competition. Therefore, it is clear, that food alone does not control survival but, when the survival first starts declining due to some other reasons, such as cannibalism during moulting or oxygen depletion in the ponds, then the lack of decline in competition helps, resulting in faster growth. The reasons for such decline in some ponds in still to be determined in prawn culture systems. Irrespective of this, the supplemental feeds do result in higher yields and the feeds IV and II and I in that order, have shown an efficient utlization by prawns. Another factor, which is important to survival is the stocking density. A series of experiments at Kakdwip centres, over a 3 year period indicated that the upper limit for stocking density can be kept at 25,000-35000. Reducing this density has not yielded any better survival.

Several authors have reported that prawns require relatively high content of protein in their diet. The diets used by Deshimaru and Shigueno (1972) for *P. japonicus* contained over 60% of protein. Lee (1971) reported optimum growth of *Penaeus monodon* at 40% protein level and the same level was established as optimum for *P aztecus* by Venkataramaiah *et al*, (1972). According to Andrew *et al*, (1972) *P. setiferus* has a required protein optimum of 28-32%. Zein-Eldin and Corliss (1976) showed 30% protein optimum for *P. aztecus*. Balazs *et al.*, (1973) reported best growth of *P. aztecus* at 25-40% protein level. The feed used by Alikunhi *et al.*, (1975) for *Penaeus monodon* contained 20% protein. All these studies reveal that requirement of protein level and its quality in diets could differ from species to species (as shown by their growth) and this species-specificity is to be emphasized in further studies. The feeds I, II and IV used in the present study had a total protein level of 24.2%, 28.9% and 35.8% respectively. At 35.8% protein level (Feed IV) the growth of *Penaeus monodon* was notably high (36 mm), the prawns having shown dailty growth increment of 1.1 mm/0.18 g, but survival was low, as mentioned earlier. Protein in the range of 20-40% seems to be sufficient in diets, to ensure growth in penaeid prawns; especially in tropical waters (Rajyalakshmi *et al.* 1979). This will reduce the cost of formulation and also ensures, a fair choice of ingredients.

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