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MASS PRODUCTION OF GREEN MUSSEL SPAT *MYTILUS VIRIDIS* LINNAEUS IN FRENCH POLYNESIA

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ABSTRACT

To develop mussel culture in tropical environment, trials for mass production of spat of *Mytilus viridis* were conducted at the Centre Océanologique du Pacifique (COP) of the Centre National pour l'Exploitation des Océans (CNEXO) in Tahiti.

This paper presents the results obtained in 800 l and 10 m^3 larval rearing tank with an initial density of 2,500 - 3,000 larvae per liter.

Metamorphosis and settlement on nylon meshes are achieved between the 15th and the 20th days. The settlement percentage is between 30 and 60 %.

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INTRODUCTION

Since 1975, the Centre Océanologique du Pacifique (COP), a laboratory of the Centre National pour l'Exploitation des Océans (CNEXO) has developped a program of studies on the Bivalve Molluscs culture in tropical area. First experiments interested larval rearing and spat production of the Pacific oyster Crassostrea gigas. They allowed to define a larval rearing method (AQUACOP, 1977), adapted from those described by Loosanof and Davis (1963) and Walne (1966).

Since 1978, studies were conducted on the tropical species Mytilus viridis, using the larval rearing method defined for C. gigas and the first results on larval development obtained by Tan (1975) and Rao et al (1976). Ten larval rearings were carried out in 800 l fiberglass tanks (AQUACOP, 1979) and one in a 10 m^3 fiberglass tank. From February 1978 to September 1979, 8.5 10^6 commercial size spat have been produced.

MATERIAL AND METHOD.

The Bivalve Molluscs hatchery is presently composed of two parts:

1) a wholly closed area, with a semi-transparent roof and fiberglass-sheet walls, containing eight double-shell 800 l cylindro-conical fiberglass tanks, thermo-regulated by circulating seawater inside the double wall. These tanks have already been described in a previous paper (AQUACOP, 1979).

2) an open area, only sheltered by a semi-transparent fiberglass roof, containing a 10 m^3 U-shaped fiberglass tank. This tank is made of a wood-frame, which subtends a transparent fiberglass sheet (see Figure 1).

In this tank, diurnal temperature variation may reach 3.5°C particularly after cold nights. Aeration is realized with a perforated pipe running on the bottom on the whole length of the tank.

The hatchery is supplied in filtered sea water (Philippe filters 5 μ and 0.5 μ).

According to the season, the mean larval rearing temperature varies from 15°C to 28°C.

Spawning is induced by thermal stimulation (19°C - 35°C), after having evaluated the maturity stage of mussels. Males and females are put apart after spawn starts. Fecondation is realized artificialy (10 spermatozoids for one ovule). The fertilised eggs are put for 24 hours in a 800 l tank until the D-larvae appear.

D-larvae are then shared out among the larval rearing tanks at the density of 3,000 larvae per liter. Water is changed every two days in the 800 l tanks. The 10 m^3 U-shaped tank is filled up progressively for the first five days and the first draining takes place at day 6, and thereafter every 3 days. Larvae are first recovered on 48 μ screens. At day 6, they are screened on 65 μ, at day 8 on 85 μ, and after day 10 on 100 μ. Countings and measurements are realized on samples taken at the moment of screenings.

Larval rearings 1 to 8 were fed on Isochrysis sp locally isolated and Monochrysis lutheri (25,000 cells of each species per ml). After metamorphosis, Skeletonema costatum was added (50,000 cells per ml).

Larval rearing 9 was fed on Isochrysis sp and Monochrysis lutheri, and after metamorphosis on Chaetoceros sp, a strain coming from Oshima,

Japan. Larval rearings 10 and 11 were fed on Isochrysis sp and Chaetoceros gracilis a strain coming from Costa-Rica (25,000 cells per ml of each species). These last two tropical strains are cultured in the COP algae room in 200 l and 300 l tanks at 25°C. Monochrysis lutheri and Skeletonema costatum are cultured at 20°C. Algae are distributed after the filling up of the tanks. Every day the remaining algae density is controlled, and if necessary larval tanks are complemented in algae up to the required density.

Treatment with 12.5 mg/m^3/day of Treflan, an herbicid used in agriculture containing 50 % Trifluralin was experimented in first three rearings. In rearing 6, an attempt to treat rearing water with one part per million of total chlorine was carried out. All other rearings were treated with 14 mg/l of sulfadimerazine every two days.

Settlement is realized on 5 mm mesh anti-hail nylon nets, which are hanging in larval tanks since pediveliger stage. In rearing 11, an experiment to estimate the settlement rate was carried out, by weighing 10 of the 80 nylon net collectors before and after settlement. About ten days after the end of settlement, nets are removed from larval tanks to a 15 m^3 pregrowth concrete tank. After larval rearing 11, some of the young spat were transfered in a pregrowth fiberglass raceway 18 m long, 0,5 m wide and 0,15 m deep. The pregrowth tanks are supplied with water from a Peneid shrimp growing pond effluent, and receive each day 7 m^3 of outdoor cultured Chaetoceros gracilis at a density of 1.2 10^6 cells per ml.

RESULTS

Spawnings : as it is shown in Table 1, spawning are obtained all year

long. When the gonads are well ripe, only one jump of temperature is needed. Fertilization rate is high (more than 90 %) and straight-hinged larvae appear within 24 hours.

Larval rearings : mean survival rate between day 2 and 10 is 70 %. The best survival rate (83 %) between day 2 and 10 was obtained in the 10 m^3 U-shaped rearing tank (rearing n° 11). Density before settlement is adjusted to 2,000 larvae per liter, as it was shown by AQUACOP (1979) that higher density at that stage induced a delay at settlement.

Treatment with Treflan for preventing fungia attack was abandoned after rearing 3, as it proved to be useless when compared with untreated tanks. Treatment with chlorine involved a complete mortality at day 6 in rearing 5 and was used no longer. Sulfadimerazine action in bacteria control gives good results (AQUACOP, 1979) and this antibiotic is used routinely.

The algae mixture Isochrysis sp - Monochrysis lutheri has been abandoned after rearing 10. In this rearing, an experiment opposed the mixture Isochrysis sp - Monochrysis lutheri to the mixture Isochrysis sp - Chaetoceros gracilis. Results are given in Table 2. The use of the two tropical strains mixture Isochrysis sp - Chaetoceros gracilis leads to a faster growth and a better survival rate at day 10. In the well-lighted 10 m^3 U-shaped tank (rearing 11), algae multiplication was higher than their consumption by mussel larvae, and this tank had not to be complemented in algae each day.

Settlement : in rearing 11, the settlement rate was estimated at 45 %. This rate takes into consideration the spat settled on the collectors and on the walls of the 10 m^3 tank (see Table 3).

Pregrowth : the commercial size of 6-7 mm was reached in one month after the end of settlement in rearing 1, 2, 3, 4. In rearing 11, two months were needed to reach the same size of 6-7 mm, because of the overload of pregrowth tanks (see Table 4). The best growth was obtained in the raceway supplied with a flow of 7 m^3 per hour of a shrimp growing pond effluent. In concrete 15 m^3 pregrowth tank, a better growth was achieved with spat lying directly on the bottom of the tank, than with spat settled on net collectors.

DISCUSSION

The use of tropical strains Isochrysis sp and Chaetoceros gracilis improved the quality of food. As a matter of fact, these two strains stay alive and keep on dividing in larval rearing tanks. Using these two species as food, the 11th rearing which was conducted in the 10 m^3 tank at the lowest mean temperature of 24.3°C with important daily variations (3.5°C) gave anyway good results.

Compared to the eight 800 l tanks, operating this 10 m^3 tank is easier for an equivalent production, and consumes less water. The use of such rearing tanks, cheap and easy to build, increases the efficiency of the method.

Improvement in the settlement rate could be obtained by hanging up more nylon net collectors in the rearing tanks. In rearing 11, the great part of spat settled on the walls of the tank indicates that the eighty collectors were insufficient to ensure whole settlement.

The use of the effluent of shrimp growing ponds as water supply for pregrowth tanks induces inequal pregrowth results, according to the phy-

toplanktonic quality of the ponds water. This cause of variations is partially reduced by the daily supply of 7 m^3 outdoor cultured Chaetoceros gracilis in pregrowth tanks. The present pregrowth equipment set limits to the potential marketable spat production of the COP at about 2.10^6 spat per month.

These first results achieved by the COP agree with the high interest which has been brought on mussel culture in Indo-Pacific region since a few years. In Tahiti, where no species of mussels live in natural environment, a large-scale culture operation had to rely on a hatchery spat production. Since 1978, maturations and induced spawnings from imported broodstock are routinely achieved throughout the year, and the larval rearing method proves to be reliable.

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Larval rearing n°	1	2	3	4	5	6	7	8	9	10	11
Date of spawning	Feb. 1978	Apr. 1978	June 1978	June 1978	July 1978	Oct. 1978	Nov. 1978	Jan. 1979	Jan. 1979	May 1979	July 1979
Number of D-larvae at day 2 (x 10^6)	7.4	10.6	1.6	7	3.9	26.4	18.2	16.7	29.3	11.5	30
Mean temperature (°C)	27.5	28.1	27	26.5		26	25.7	27.1	28	26.7	24.3
Survival rate (%) at day 10	81	76	63	59	mortality (a)	56	74	mortality (b)	78	65	83
Day of beginning of settlement	19	15	15			16	18		18	15	16
Day of end of settlement	26	22	0.43			26					26
Commercial size spat (x 10^6)	0.35	1.03				1.04	1.98		1.6	0.31	1.8
% Spat / D-larvae at day 2	5	10	5			4	11		5	3	6

Table 1 : Larval rearings of Mytilus viridis in the COP
(a) Mortality after treatment with 1 ppm total chlorin
(b) Mortality by bacterial disease

Day	Rearing 10 (a)				Rearing 11 (b)	
	Isochrysis sp *Monochrysis lutheri*		*Isochrysis* sp *Chaetoceros gracilis*		*Isochrysis* sp *Chaetoceros gracilis*	
	Size (μ)	Survival rate (%) from day 2	Size (μ)	Survival rate (%) from day 2	Size (μ)	Survival rate (%) from day 2
1						
2						
3					76	
4					81	
5	90.6	95.4			85	
6	100.8		116.6	89.5	93	
7	109.7	81.8	134.3		115	
8	119		144.4	81.7		
9	129.7	72.3	171.4		154.3	
10	151		192.2	80 (c)		
11	164	66 (c)	206.3			
12			237.1		220	83 (c)
13	206		252			
14			280		255	
15	233		settlement		286	
16					settlement	
17	settlement					

Table 2 : Influence of algae mixture *Isochrysis* sp - *Monochrysis lutheri* and *Isochrysis* sp - *Chaetoceros gracilis* on the larval growth of *Mytilus viridis*

(a) Rearing 10 in 800 l tanks (b) Rearing 11 in 10 m^3 tank
(c) Screening on 100 μ mesh

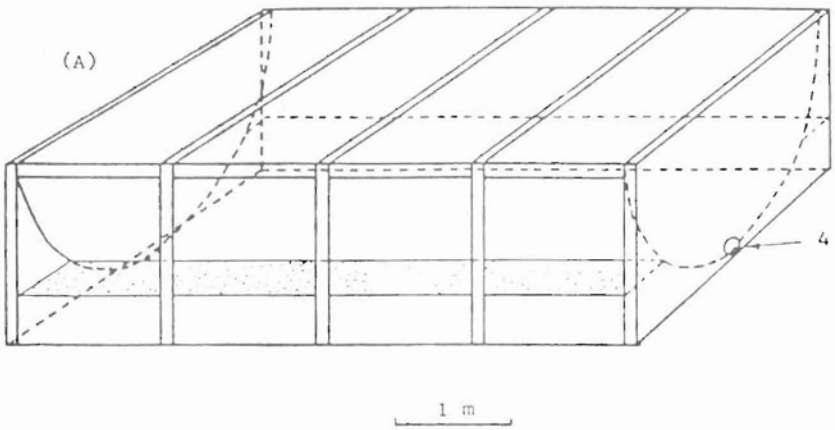
Number of pediveliger larvae at day 15	20 10^6
Mean number of spat per collector	72,000 ± 18,700 (p = 0.05)
Total number of spat on collectors (day 34)	5.8 10^6 ± 1.5 10^6
Number of spat settled on walls (day 34)	3.1 10^6
Settlement rate (between day 34 and day 15)	45 %

Table 3 : Estimation of the settlement rate in rearing 11

Days after settlement	Pregrowth					
	net collectors		tank bottom		the raceway	
	W (mg)	L (mm)	W (mg)	L (mm)	W (mg)	L (mm)
24	4.1	2.5				
30	4.2					
36 (a)	5.9	3.3	5.9	3.3	5.9	3.3
43	7.8	3.5			9.7	4.2
50	11.7		18.3	4.6	22.2	
57	13.9	4.4	25.6	5.5	60	6.6
64	25.8	4.6	44.7	6.3		

Table 4 : Growth in weight (W mg) and size (L mm) of spat of *Mytilus viridis* in rearing 11

(a) Partial removal of spat from collectors



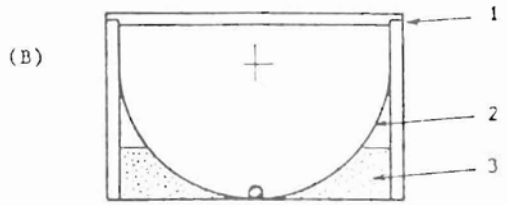


Figure 1 : 10 m^3 U-shaped tank

(A) General view

(B) Cross-section

1 - Wooden frame

2 - 1 mm fiberglass sheet

3 - Bed of sand

4 - Draining pipe