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EXPERIMENTAL CULTIVATION OF *GRACILARIA EDULIS* AT VALINOKKAM BAY

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ABSTRACT

Experimental field cultivation of the agar yielding red alga *Gracilaria edulis* was carried out at Valinokkam Bay from May 1992 to April 1994 at 1.5 to 3.0 m depths using 2x2 m size coir rope nets fabricated with 1" thick coir ropes and 1" thick long line coir ropes. The seedlings cultured on nets and long line ropes during May to December in 1992 and 1993 degenerated due to sedimentation and low light intensity. The growth of *G. edulis* seedlings from January to April during 1993 and 1994 was good and reached harvestable size of 14.4 cm and 22.9 cm (mean length) after 45 and 90 days respectively. Harvest could not be made,as many of the grown up plants were grazed by fishes. Data collected on environmental and hydrological parameters from the culture site at fortnightly interval were correlated with the growth of cultured seaweed. The result obtained in this experiment is compared with the results on the experimental field cultivation of *G.edulis* carried out in the nearshore areas of Mandapam and lagoon of Minicoy (Lakshadweep).

INTRODUCTION

In India seaweeds are mostly used as raw material for the production of phytochemicals agar and sodium alginate. There are about 30 agar and algin producing seaweed industries located at different places in the maritime states of Tamilnadu, Andhra Pradesh, Pondicherry, Kerala, Karnataka and Gujarat. At present the red algae *Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa* and *G. foliifera* are used as raw material for extraction of agar and species of *Sargassum* and *Turbinaria* for sodium alginate. All these seaweed industries get the raw materials exploited from the natural seaweed beds occurring in the southeast coast of Tamilnadu from Rameswaram to Kanyakumari and Gulf of Mannar islands. The commercial harvesting of seaweeds from these areas is going on since 1966. The data collected by the Central Marine Fisheries Research Institute on the seaweed landings of Tamil Nadu from 1978 to 1993 show that the quantity of agar yielding seaweeds landed annually varied from 248 to 1289 tonnes (dry wt) and algin yielding seaweeds from 651 to 5537 tonnes (dry wt).

The quantity of agarophytes are insufficient to meet the raw material requirement of agar industries, as many agar manufacturing industries have come up in India in recent years. With a view to develop technology for commercial scale cultivation of agarophytes, attempts have been made on experimental field cultivation of agar yielding seaweeds

Gelidiella acerosa (Krishnamurthy *et al* 1975; Subbaramaiah *et al* 1975; Chennubhotla *et al* 1987; Patel *et al* 1979 and 1986) and *Gracilaria edulis* (Raju and Thomas, 1971; Umamaheswara Rao 1973 and 1974; Krishnamurthy *et al* 1975 and 1977; Chennubhotla *et al* 1978, 1987 and 1992; Paramasivam and Devadoss, 1987 and Kaliaperumal *et al* 1992 and 1993) at different environments using various culture techniques. To explore the possibility of *G. edulis* cultivation at Valinokkam Bay, field experiments were conducted at 3 sites (1.5 and 3.0 m depths) in the Bay from May 1992 to April 1994 using long line rope and coir rope nets. Data on clarity of water, light intensity, sedimentation, wave action, epiphytes, epifauna and predators were collected from the culture site. Data on hydrological parameters were also collected and the results obtained on all these aspects are presented in this paper.

MATERIALS AND METHODS

Coir rope nets of 2 x 2 m size with 12 cm mesh fabricated with 1" thick coir rope and 1" thick long line coir ropes were used in this study. Young and healthy plants of *Gracilaria edulis* (Gmelin) Silva collected from Thonithurai near Mandapam and transported to Valinokkam by road in plastic drums with seawater were used as seed material, since *G.edulis* plants do not occur at Valinokkam. Fragments of *G. edulis* (about 6 cm long) obtained from mother plants were inserted in the twists of coir ropes and nets. In each net 4 kg and long line 1 kg of seed material were introduced and the seeded ropes and nets were tied tightly to the casuarina poles erected in the culture sites in such way that they were always submerged in seawater and 50 cm above the sea bottom. In each month 4 to 6 numbers of coir rope nets and 4 to 6 long line ropes of 20 m length each with seed material were introduced in the culture sites. Observations were made regularly at fortnightly intervals on the growth of seedlings, sedimentation on nets, other algal growth, attachment of animals, grazing by fishes and sea conditions. The ropes and nets without the growth of seedlings were removed after 30 days.

Data on environmental factors such as water clarity, water temperature and sedimentation were collected from the culture site at 15 days intervals. Water samples were also collected at 12.00 hr and analysed for salinity, dissolved oxygen and nutrients such as phosphate, silicate, nitrite and nitrate following the method given by Strickland and Parsons (1968). Monthly mean values obtained for different ecological and hydrological parameters are given in Table 1 and 2. For collection of data on sedimentation the method described by Kaliaperumal *et al* (1993) was followed.

RESULTS

In all the nets and long line ropes introduced from May to December during the two years 1992 and 1993, the seedlings degenerated after 15 to 30 days. This was due to deposition of heavy sediments all over the surface of seedlings affecting the photosynthetic activity and in turn the growth of plants. The low light intensity due to the turbulent condition of the sea caused low photosynthetic activity of seedlings leading to its gradual degeneration. The failure of crop during the above period was also due to

Table 1 Data collected on environmental and hydrological parameters from the seaweed culture site at Valinokkam Bay

Month	Water clarity	Water depth (cm)	Secchi disc visibility from surface (cm)	Turbidity (K)	Sedimentation (g/l/24h)	Temperature AT	SWT	BWT	Dissolved oxygen (ml/l) Surface	Bottom	Salinity (%) Surface	Bottom
May'92	Turbid	131	58	2.931	Note collected	33.4	30.4	30.0	4.71	4.01	35.80	35.95
June	"	121	50	3.400	"	33.8	29.3	28.8	3.85	3.64	36.68	36.80
July	"	113	414.146	"	"	33.5	30.2	30.5	4.72	4.79	35.44	35.44
August	"	103	46	3.696	"	32.5	31.0	31.3	6.32	6.48	35.52	35.68
Sept.	"	109	58	2.931	"	33.0	30.4	30.7	6.21	5.91	35.60	35.84
Oct.	"	116	39	4.359	1.194	32.3	30.8	30.7	4.63	5.29	36.40	36.00
Nov.	"	126	21	8.095	1.848	30.0	29.2	29.0	3.73	5.87	34.40	34.56
Dec.	"	95	55	3.090	1.514	29.3	27.2	27.2	5.99	6.00	30.40	30.72
Jan.93	Clear	112	112	1.518	0.580	28.0	27.0	27.0	6.37	6.09	32.48	32.80
Feb.	"	132	132	1.288	0.861	29.6	28.9	29.2	4.76	4.74	32.64	33.28
Mar.	"	107	107	1.589	0.766	33.8	31.7	31.2	5.83	5.97	34.00	35.04
Apr.	"	120	120	1.417	0.828	34.1	33.4	33.8	5.72	5.26	33.60	34.16
May	Turbid	113	80	2.125	1.196	34.1	32.8	33.3	4.81	4.64	35.04	35.52
June	"	117	62	2.742	1.164	35.4	30.8	31.2	6.80	6.25	35.20	35.52
July	"	118	49	3.509	1.119	32.0	31.3	31.1	4.85	5.43	36.52	36.72
Aug.	"	93	68	2.700	0.852	32.4	31.2	31.4	5.90	5.39	37.12	37.12
Sept.	"	109	67	2.584	0.772	33.5	32.3	31.8	5.42	4.92	36.24	36.08
Oct.	"	143	60	3.145	1.154	33.6	29.6	30.2	4.74	4.72	33.60	34.00
Nov.	"	95	43	4.129	0.913	29.7	29.8	29.9	5.53	5.57	30.40	30.08
Dec.	"	95	60	3.429	0.659	29.9	29.7	29.5	5.27	5.26	31.60	32.80
Jan 94	Clear	125	125	1.360	1.120	32.5	31.4	31.2	4.94	4.85	32.80	33.20
Feb	"	94	94	1.809	0.496	29.4	28.9	28.2	4.96	4.87	30.00	31.20
Mar.	"	97	97	1.753	0.466	31.1	30.4	30.5	5.72	5.39	32.40	32.80
Apr.	"	140	140	1.214	Not collected	33.0	33.4	34.0	4.14	4.43	28.80	28.80

attachment of hydroid colony, polychaete egg mass and epiphytic growth of the blue-green alga *Lyngbya majuscula* on the nets and ropes.

The growth of seedlings on the nets and long line ropes introduced during January to April during 1993 and 1994 in all three culture sites was good because of good water clarity without sedimentation and attachment of organisms. The seedlings grew to harvestable size plants after 45 days with a mean length of 14.4 cm (maximum height of 17.0 cm) during the period January to April '93 and mean length of 22.9 cm (maximum length of 41.0 cm) after 90 days during the period January to April '94. But the crop could

Table 2 Data collected on hydrological parameters from the seaweed culture site at Valinokkam Bay

Month	Phosphate (µg at/l)		Silicate (µg at/l)		Nitrite (µg at/l)		Nitrate (µg at/l)	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
May'92	0.18	0.18	19.00	19.00	0.02	0.02	0.88	0.75
June	0.15	0.20	15.00	19.50	0.02	0.02	1.50	1.50
July	0.05	0.09	14.75	15.25	0.03	0.02	1.63	1.50
August	0.10	0.08	18.00	11.00	0.04	0.11	1.19	1.63
September	0.12	0.17	20.25	18.75	0.02	0.03	2.13	2.00
October	0.05	0.08	10.00	14.00	0.03	0.02	2.13	4.25
November	0.05	0.05	4.00	5.00	0.08	0.11	2.25	1.50
December	0.15	0.20	14.00	13.00	0.01	0.02	0.75	2.50
January'93	0.05	0.05	19.00	17.00	0.02	0.02	1.13	0.88
February	0.10	0.09	14.75	18.50	0.05	0.05	0.38	0.44
March	0.13	0.13	13.50	14.00	0.09	0.02	0.50	1.61
April	0.14	0.13	18.00	15.75	0.02	0.02	0.81	0.44
May	0.15	0.09	10.00	6.00	0.04	0.03	0.50	1.31
June	0.08	0.10	1.00	4.00	0.02	0.13	0.50	1.25
July	0.13	0.19	15.50	18.50	0.03	0.03	0.94	1.25
August	0.15	0.12	16.00	17.00	0.03	0.03	1.00	1.13
September	0.18	0.23	14.50	17.00	0.03	0.13	1.82	1.13
October	0.19	0.17	17.00	16.00	0.04	0.03	1.43	1.20
November	0.24	0.25	21.00	18.50	0.04	0.03	1.78	1.75
December	0.27	0.30	20.00	18.50	0.04	0.03	1.75	1.55
January'94	0.15	0.20	26.50	28.50	0.01	0.01	0.08	0.54
February	0.20	0.13	30.25	27.00	0.01	0.01	0.57	0.69
March	0.22	0.40	28.22	32.00	0.01	0.02	0.75	0.75
April	0.18	0.10	21.00	17.50	0.02	0.02	1.00	0.88

not be harvested as most of the grown up plants on the nets and long line ropes were grazed by fishes.

The data collected on ecological and hydrological parameters from the seaweed

culture site from May '92 to April '94 are given in Table 1 and 2. The water was turbid from May to December in 1992 and 1993 and clarity occurred during the period January to April in 1993 and 1994. The values for turbidity (K) ranged from 2.125 to 8.095 and 1.214 to 1.809 during the above two periods. The values for sedimentation varied from 0.466 to 1.848 g/l/24 hr. The atmospheric, surface water and bottom water temperature varied from 28.0 to 35.4°C, 27.0 to 33.4°C and 27.0 to 34.0°C respectively. In the surface water, the values for dissolved oxygen and salinity ranged from 3.73 to 6.80 ml/l and 28.80 to 37.12‰ respectively. The phosphate content varied from 0.05 to 0.27, silicate from 1.00 to 30.25, nitrite from 0.01 to 0.09 and nitrate from 0.08 to 2.25 µg.at/l. In the bottom water, the dissolved oxygen varied from 3.64 to 6.48 mg/l and salinity from 28.80 to 37.12‰. The phosphate content ranged from 0.05 to 0.40, silicate from 4.00 to 32.00, nitrite from 0.01 to 0.13 and nitrate from 0.44 to 4.25 µg.at/l.

DISCUSSION

The present investigation shows that the period between January to April is suitable for cultivation of *G. edulis* at Valinokkam Bay in the Gulf of Mannar area when the water is clear with very good light penetration and without sedimentation and attachment of other organisms. The crop could be obtained by preventing of grazing plants by fishes. The growth rate of cultured *G. edulis* at Valinokkam can be compared with the experiments conducted with *G. edulis* in the nearshore areas of Mandapam (Umamaheswara Rao 1974; Chennubhotla *et al* 1978; 1987 ; Kaliaperumal *et al* 1993), lagoon of Krusadai island near Mandapam (Raju & Thomas 1971; Krishnamurthy *et al* 1975; 1977) and Minicoy island of Lakshadweep (Kaliaperumal *et al* 1992; Chennubhotla *et al* 1992). It also reveals that sedimentation, light intensity, water turbidity, water temperature, water current, water quality were action, epiphytes epifauna and grazing by fishes are the factors affecting the growth of cultured *G. edulis*. This is in conformity with the earlier findings on the field cultivation of *G. edulis* (James *et al* 1986; Chennubhotla *et al* 1987; Kaliaperumal *et al* 1993) that sedimentation, epifauna and grazing by fishes affect the growth of *G.edulis*.

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