Indian J. Fish., 46(2) : 185-189, Apr.-Jun., 1999

Note

Seasonal variation in the growth of *Gracilaria edulis* (Gmelin) Silva cultured from spores

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ABSTRACT

An year-round experiment was conducted in the culture of *Gracilaria edulis* by reproductive method in the Gulf of Mannar and Palk Bay, near Mandapam, along the southeast coast of India. The spores liberated on cement blocks were transplanted to Palk Bay in April after 17 days of spore output and nursery rearing. The germlings were transferred to the Gulf of Mannar during August when the size of the plants ranged between 0.3 and 1.9 cm (mean 0.88 cm) with a crop growth rate of 0.011 cm/day. The CGR was more pronounced from October being 0.043 cm/day and increased gradually till harvest reaching a peak value of 0.650 cm/day during March. The harvested plants were young, healthy and sterile. October to March was found to be the most suitable period for cultivation.

In India, *Gracilaria edulis* (Gmelin) Silva is considered the most important agarophyte having high regenerative capacity. The species is propagated vegetatively on long line coir ropes, net, nylon rope, floating rafts, in ponds, tanks, raceways, nearshore and offshore areas of seas (Umamaheswara Rao, 1973, 1974;Krishnamurthye£a/., 1975; Chennubhotla *et al.,* 1978). Several research groups have explained the need for mass production of *Gracilaria* from spores similar to those used for other seaweeds (Levy *et al.,* 1990; Glenn *et al,* 1996; Alveal *et al,* 1997). Initial work carried out on the reproductive propagation of *Gracilaria* in India met with failure or limited success (Reeta, 1990; 1992; Reeta and Kaliaperumal 1991; Charles, 1992; Oza *et al.,* 1994). The present work was to find out the suitable culture period for large scale cultivation of *Gracilaria edulis* from spores along the southeast coast of India. The climatic conditions of Mandapam are affected by both south-west and northeast monsoons, thus, Palk Bay remains turbulent from October to March and Gulf of Mannar from April to September. The present experiment was carried out from April 1992 to March 1993.

Gracilaria edulis was collected from the intertidal area of Gulf of Mannar near Thonithurai and transported to the laboratory in plastic bags. Healthy cystocarpic plants were sorted out and washed several times to remove the epiphytes. The cleaned plants were used

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for spore liberation in a 250 1 fibreglass tank containing filtered sterilised seawater. Spore liberation and nursery rearing was carred out by the method explained by Reeta and Ramamoorthy (1997).

Regular microscopic observations were made on the growth of the spores till 17 days when erect frond developed from the central medulla of the circular parenchymatous disc. At this stage the germlings were transplanted to Palk Bay (Fig. 1) April and transferred to Gulf of Mannar in August. Regular observations were made on the growth of the plants. Water samples were taken on each observation day to estimate the nutrient content, dissolved oxygen and salinity of seawater. Data on total rainfall, maximum and minimum atmospheric temperature were obtained from the Central Electro-Chemical Research Institute, Mandapam Camp and from the Pamban Meteorological Centre. The details of-the culture sites are as given in Reeta, 1997.

Visible germlings appeared on the substrata 22 days after transplantation and their length were measured using vernier calipers. The size ranged between 0.1 and 0.3 cm (mean 0.2 cm) 30 days after transplantation with a crop growth rate (CGR) of 0.007 cm/day. The plants were infected with heavy manifestation of slimy growth and epifauna such as barnacles, brittle stars and gastropods. Some of the germlings were nibbled at the tip. Thus the growth was affected and the maximum size of the plants was only 0.49 cm (±0.26 cm) even three months after transplantation. The germlings were treated with 0.1 %

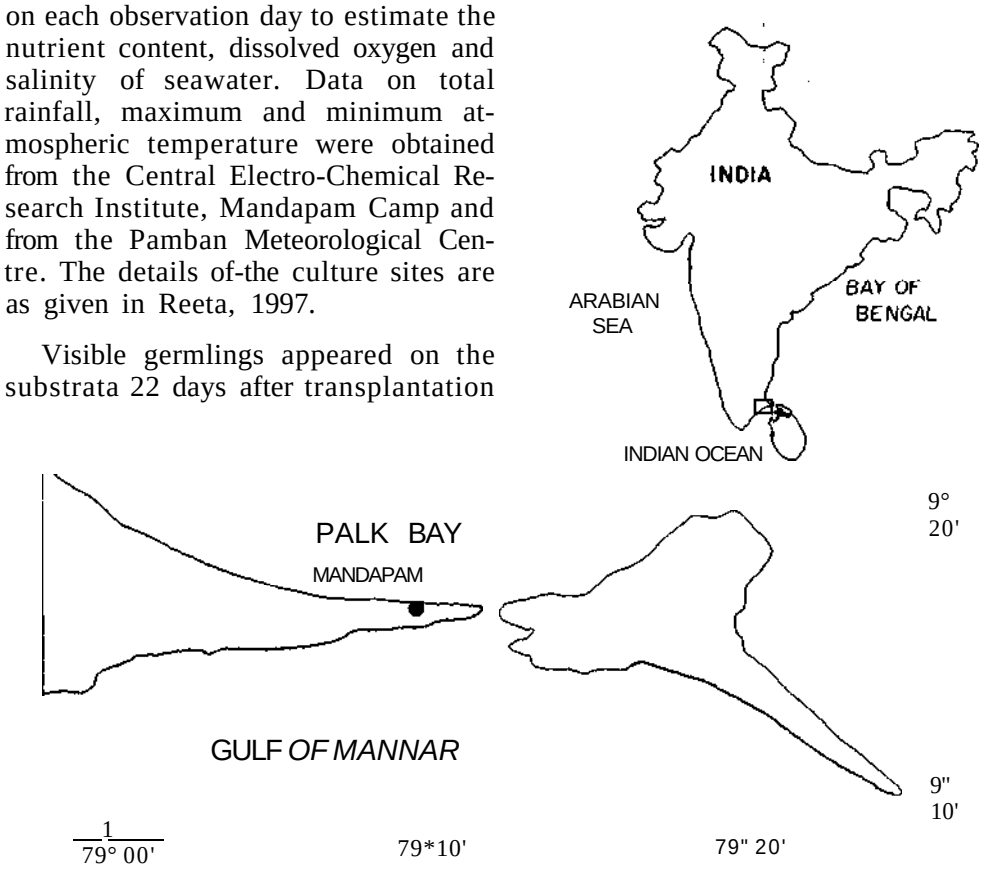

Fig. 1. India map showing Gulf of Mannar and Palk Bay along the southeast coast of Tamil Nadu.

NaOCl solution before transplanting them to the Gulf of Mannar. The germlings were transferred to the Gulf of Mannar during August when the plant size ranged from 0.3 to 1.9 cm with CGR of 0.011/cm day. There was a pronounced increase in the crop growth rate in October, when CGR was 0.043 cm/day and height ranged between 2.0 and 4.0 cm (mean 3.17±1.04 cm, n = 16) to March when the plant attained a maximum size of 30.5 cm (mean length 19.45 ± 5.03 cm) and CGR day 0.65 cm/day (Table 1). The plants were harvested at this stage before the sea became turbulent.

Temperature and salinity were both relatively low during the peak period of growth. The dissolved oxygen content was higher in the Gulf of Mannar than in Palk Bay during July-September, but the salinity of seawater was very high which might have resulted in the sluggish growth of the plants during this period. The nutrient content of seawater varied widely throughout the year but nitrite and phosphate were the highest during the peak period of growth (Table 2). Peak growth period coincided with maximum rainfall from October to December, accounting 77.8 % of the total annual rainfall. The salinity of the seawater decreased from 34.0 to 28.8 ppt from November to December due to the heavy rainfall (376.9 mm) during November. The growth of the plant showed significant negative correlation with salinity (r=-0.729).

Nursery rearing of the spores to the germling stage in the laboratory skips factors such as wave action and predation and helps to increase the survival percentage of spores. The holdfast of the plant is able to attach to the substratum firmly before the germling is exposed to the strong wave action of the sea. Transplantation of germlings into the sea during unfavourable periods not only reduced the crop growth rate of the plants but also the survival rate of the germlings. In the present experiment, it was observed that after a lag period of six months from the date of transplantation, the crop growth rate increased after October and plants reached harvestable size in March. Similar results were obtained by Reeta and Ramamoorthy (1997) who transplanted

TABLE 1. *Growth parameters during culture period*

Months	Size range (cm)	Mean size (cm)	Sd(±) (cm)	CGR cm/day	Culture site
Apr. '92	0.1-0.3		-	0.007	Palk Bay
May	0.1-0.5		-	0.011	Palk Bay
Jun.	0.5-1.0		0.25	0.021	Palk Bay
Jul.	0.1-0.8		0.26	0.015	Palk Bay
Aug.	0.3-1.9		0.38	0.011	Gulf of Mannar
Sep.	0.5-2.0		0.49	0.012	Gulf of Mannar
Oct.	2.0-4.0		1.04	0.043	Gulf of Mannar
Nov.	1.3-10.0		2.89	0.044	Gulf of Mannar
Dec.	3.0-10.5		1.98	0.031	Gulf of Mannar
Jan. '93	5.5-14.5		2.56	0.185	Gulf of Mannar
Feb.	12.0-26.0		4.45	0.229	Gulf of Mannar
Mar.	14.5-30.5		5.03	0.650	Gulf of Mannar

CGR - Crop growth rate, Sd - Standard deviation.

TABLE 2. *Environmental and hydrological parameters during culture period*

Months	Max. temp CO	Min. Temp CC)	SWT CC)	DO (ml/1)	Salinity (ppt)	Rainfall (mm)	$N0_3$ (ugatom/1)	$N0_2$ (fig aU>m/l)	PO< (ug atom/1)	$Si0_3$ (pg atom/1)
Apr. '92	33.29	26.55	32.60	2.09	34.1	2.2	1.50	0.263	0.15	18.0
May	32.39	27.17	29.80	2.79	34.0	68.3	1.00	0.021	0.15	17.0
Jun.	30.32	25.63	29.00	2.10	35.0	2.6	2.00	0.032	0.10	12.0
Jul.	30.57	25.45	29.60	2.45	36.0	-	1.30	0.021	0.05	18.0
Aug.	30.29	25.31	30.20	6.24	36.0	43.0	1.80	0.042	0.05	18.0
Sep.	32.68	26.32	34.40	6.19	36.0	62.6	0.05	0.021	0.10	17.0
Oct.	31.49	24.98	30.40	6.30	36.0	99.4	1.75	0.021	0.05	14.0
Nov.	31.59	24.22	30.20	3.38	34.0	376.9	2.88	0.021	0.05	11.0
Dec.	31.02	23.09	29.40	5.61	28.8	128.6	1.38	0.011	0.10	18.0
Jan. '93	32.18	23.16	29.00	3.82	27.2	16.6	0.88	0.021	0.05	6.0
Feb.	33.56	23.56	28.00	5.30	30.0	5.6	2.00	0.042	0.08	13.0
Mar.	34.26	24.12	32.00	5.67	30.0	-	0.38	0.020	0.15	28.5

$N0_3$ - Nitrate, $N0_2$ - Nitrite, $P0_4$ - Phosphate, SiO_a - Silicate, DO - Dissolved oxygen, Max. Temp.- Maximum temperature, Min. temp. - Minimum temperature, SWT - Surface water temperature.

the germlings to the Gulf of Mannar during October and harvested the cultured plants in two consecutive harvests in January and March. Thus October to March appears to be the most suitable culture period for *Gracilaria edulis* in the Gulf of Mannar among the south-east coast of India.

Acknowledgments

The authors are thankful to Dr. P. S. B. R. James the former Director, CMFRI for providing necessary facilities to carry out the work. Thanks are due to the present Director Dr. M. Devaraj for his constant encouragement. The authors are also thankful to the Officer-in-charge, Central Electro Chemical Research Institute, Mandapam Camp and Pamban Meteorological Centre for providing necessary data on weather.

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