



# समुद्री मात्स्यकी सूचना सेवा

## MARINE FISHERIES INFORMATION SERVICE

No. 117

JULY, AUGUST, SEPTEMBER 1992



तकनीकी एवं TECHNICAL AND  
विस्तार अंकावली EXTENSION SERIES

केन्द्रीय समुद्री मात्स्यकी CENTRAL MARINE FISHERIES  
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## ON THE SUCCESSFUL CULTURE OF GRACILARIA EDULIS FROM SPORES \*

*Gracilaria* is a commercially valuable agarophyte and its many species are distributed throughout the temperate and tropical seas. With the increasing demand of agarophytes by the industries and the declining trend of wild resources of these seaweeds due to over exploitation, suitable culture method is entailed for increasing their production. Two important culture methods are fragment culture and spore culture. The fragment culture has been tried on an experimental scale in India with economically important seaweed such as *Gelidium acerosa*, *Gracilaria edulis*, *Hypnea musciformis*, *Acartophora spicifera* and *Ulva lactuca*. In *Gracilaria edulis*, the fragment culture has been carried out in seawater aquarium, inshore water of Gulf of Mannar, open shore environment, sandy lagoon and Lakshadweep Island by long line rope, nylon rope, coral stones and nets of coir rope.

The life cycle of *Gracilaria* consists of an alternation of isomorphic phase with unisexual gametophytes. The spermatia are produced in the shallow depression of the male plant. Cystocarps are usually prominent hemispherical structure projecting from the thallus surface. Large number of carpospores are embedded in the globular cystocarps. The spores of *Gracilaria edulis* from the cystocarpic and tetrasporic plants were liberated on the nylon raphae and transplanted to the sea within two days of their output under the Bay of Bengal Programme during 1988-'89 at Vedalai and Chinnapalam of Ramanathapuram district. The work was carried out on a large scale but it was a total failure as the spores could not be grown to germling stage (*Bay of Bengal News*, No. 45, March 1992). The reasons attributed for the failure of the crops were predation by rabbit fish, difference between native habitats and the target species, the firm site, unpredictable change of life cycle and lack of access to alternate sites.

CMFRI have taken up the culture of *Gracilaria edulis* from spores on an experimental scale since 1988 liberating the spores on different substrata like coir rope, circular cement blocks, nylon ropes, coral stones and nylon raphae.

Series of experiments were conducted to come out with a suitable technology for large scale cultivation.

### **Culture of *G.edulis* from spores sans nursery rearing**

The experiment was started from November 1988 and continued till April 1989, liberating the spores (both carpospores and tetraspores) on cement blocks in plastic trough of 50 l capacity containing unsterilized seawater with moderate aeration. The substrata with the spores were transferred to natural environment at Gulf of Mannar near CMFRI jetty after 4 days of their output. No regular observations were made on the growth of the spores. After 40 days of transplantation young germlings of 2-8 mm size appeared on the cement blocks, which grew to 5020 mm in February. The germlings were again transferred to Palk Bay side, when Gulf of Mannar became turbulent. In April, the plants reached to harvestable size (Maximum length 16 cm; mean length 7.8 cm) after 4 months. The other alga found attached to the substrata were *Ulva lactuca*, *Enteromorpha intestinalis*, *Cladophora* spp., *Padina boergestrui* and *Hypnea valentiae*. In this experiment although a large number of spores were transplanted to the sea, only few of them grew to young plants. It was felt necessary to provide the spores with nursery rearing to germling stage before transplanting (Jayasankar *et al.*, 1991, *Seaweed Res. Util.*, 14(1): 21-23).

### **Nursery rearing of spores to germlings under running seawater**

From October 1989, experiments were carried out liberating the spores on cement blocks, coir ropes and coral stones in 1 ton capacity tank containing filtered and stagnant seawater. The spores got attached to the substrata within 16-24 hours of their output, when the reproductive plants were removed. Air and water supply were provided after one day. Regular observation on the growth of the spores settled on glass slides were taken by measuring their diameter using ocular micrometer. Trans-

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plantation of the substrata to the natural environment was done at different days of spore output at every 5 days intervals. One set was kept for nursery rearing. It was observed that the plant grew to 3 - 7 cm length when the spores were transplanted to natural environment from 13 - 18 days of their output. Microscopic observation showed an erect frond developed from the parenchymatous disc of the dividing spores within 15 - 17 days of their output when the size of the circular parenchymatous disc grew to 557/ $\mu$ m in diameter (Figs 1 & 2). Measurement of the germlings were taken by vernier calipers. The germlings grew to 1.40 - 3.80 mm after 47 days of spore output in the nursery tank. On completion of 165 days, the germlings grew to a maximum length of 34 mm which is apparently a slow growth (Jayasankar, *CMFRI Newsletter*, No. 49, 1990). This necessitates transplantation of the germlings to natural environment after nursery rearing of 13 - 18 days.

**Nursery rearing of spores in controlled room environment and transplant of germlings to sea for further growth**

The spores were liberated from the matured female plants of *G.edulis* on cement blocks, coir ropes, nylon ropes and glass slides in 50 l capacity plastic trough containing sterilized seawater. After 24 hours of spore liberation, they were transferred to the culture room and kept at a temperature range of 23 - 25°C, light intensity of 1000 lux and photoperiod of 16:8 h light and dark cycle. Microscopic observation on the growth of the spores was taken under Olympus monocular microscope. It was observed that the growth of the dividing spores in enriched medium



Fig. 1. Growing spores of *G. edulis* on glass slides ( 10 x 10 magnification)

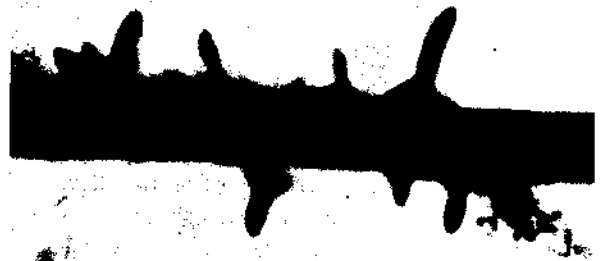


Fig. 2. Growing spores of *G. edulis* on coir ropes (10 x 40 magnification)



Fig. 3. Young germlings of *G. edulis* on cement blocks.



Fig. 4. Fully grown plant of *G. edulis* on cement blocks (Arrow showing epiphyte of *Ulva reticulata*).

(Conway and Walne's medium) was double to that growth in sterilized seawater and running seawater. The substrata with spores attached to them were transplanted to natural environment after 15 - 17 days of spore output when the erect frond developed. The transplantation was done in the Gulf of Mannar near CMFRI jetty during November 1991. Observations on water quality such as salinity, dissolved oxygen, pH, nitrite, nitrate, phosphate and silicate were made at weekly intervals. After one month of transplantation, young germlings of 3 - 7 mm size appeared during December which reached to harvestable size (maximum length 8.1 cm) after 4 months of spore output. In each substratum, there was luxuriant growth of the seaweeds which were healthy too, thus showing better growth and survival when reared in enriched medium for 17 days in culture room with a weekly change of medium (Figs. 3 & 4). Observations made on the growth of spores reared in enriched medium in outdoor en-

vironment, showed good growth but the pigment content were less compared to those reared in controlled room environment.

Further work is being pursued in these lines in Palk Bay, Krusadai Island, Gulf of Mannar near Pamban bridge and Thonithurai to find out a suitable culture sites during different seasons. The hitherto experience on the spore culture method of *Gracilaria edulis* apparently suggests the need to rear its spores to germling stage in enriched medium before transplantation. Rearing of germlings in 0.1 - 0.5% enriched medium can increase the size of the parenchymatous disc of the dividing spores, thereby allowing the spores to attach firmly to the substrata. Smooth substrata such as glass slides and nylon raphae are not suitable as there is every chance of germlings getting dislodged from the substrata in wave action. Hard substrata such as coir ropes, coral stones and cement blocks are ideal for spore attachment.