A pilot study on the growth performance of red seaweed, *Gracilaria corticata* in different salinities

M. T. Shilta *, Ramya Abhijith, K. Vinod, P. K. Asokan and Imelda Joseph
Calicut Regional Station of ICAR-Central Marine Fisheries Research Institute, Kozhikode-673 005, Kerala

*E-mail: shiltathomas@gmail.com

ABSTRACT

Gracilaria, the third largest genus in the red algal group Rhodophyta is a diverse genus with cercial significance for agar production. Present work was carried out under controlled indoor conditions, to determine the optimal salinity requirement for *G. corticata*. Raft culture in plastic crates using different salinity levels was employed. The vegetative thalli of *G. corticata* were collected from the intertidal region during low tide from Thikkodi, Kozhikode. Ten polypropylene ropes were tied parallel at 10 cm intervals on the plastic rafts and introduced into the rectangular plastic crates of 60 x 40 x 30 cm^3. About 100 g of *G. corticata* were used as seeding material on rafts and are introduced to different salinities viz 5, 10, 15, 20, 25, 30 and 35 ppt in triplicates for 30 days. Thalli growth was recorded the fastest in crates containing full strength seawater (35 ppt) and successively slower in crates with lower salinities. After 30 days of culture period, mean weight of seaweed harvested from each treatment was 108±8.5 g (20 ppt), 155±12.5 g (25 ppt), 156±10.2 g (30 ppt) and 160±12.8g (35 ppt). The results indicated that *G. corticata* can be cultured using raft method at salinity above 25 ppt. The reduction in the level of nutrients like ammonia, silicate and phosphate in the culture system indicated that the nutrients were utilized by *G. corticata* for their growth. Future studies with *G. corticata* in field trials in integrated multi-trophic aquaculture (IMTA) would prove its feasibility in nutrient load reduction in the estuarine as well as coastal waters.

***Keywords**: Red seaweed, Gracilaria corticata, salinity, raft culture*

Gracilaria corticata is one of the commercially important red seaweed available in India in the marine environment and it is widely present in the estuarine waters of Kozhikode. *G. corticata* has applications in industrial and biotechnology sectors due to the presence of important constituents like α-(1,4)-3,6-anhydro-l-galactose and β-(1,3)-d-galactose which is one of the main component of agar. *Gracilaria* spp. was once considered unsuitable for agar production due to their low gel strength but later it was observed that pre-treatment with alkali prior to extraction produced agar with higher gel strength. This innovation resulted in harvesting a variety of wild species of *Gracilaria* in Chile, Argentina, Indonesia and Namibia. Experiments on cultivation of various species like *G. asiatica* (stake-net culture), *G. sjoestedtii*, *G. lichenoides* (pond culture), *G. tenuistipitata* (raft culture), *G. domingensis* (stake-rope culture), *G. vermiculophyla* (IMTA tanks), have been successfully attempted in many countries.

The estuarine waters of Kozhikode, Kerala on the west coast of India has a wide range of seaweed diversity and *G. corticata* is one of the dominant species present. The present work was carried out to determine the optimal salinity requirement for *G. corticata* in raft culture in plastic crates under controlled indoor conditions in different salinity levels. The vegetative thalli of *G. corticata* were collected from the intertidal region during low tide from Thikkodi and cleaned with a brush and tissue paper to remove the epiphytes and other attached

Gracilaria corticata

G. corticata in plastic crates maintained in different salinities

Bleaching observed in 5-15 ppt salinity

Bleaching and algal infestation observed in 5 ppt salinity

Bleaching and algal infestation observed in 10 ppt salinity

Bleaching observed in 15 ppt salinity

organisms/dirt. The trials were carried out in rectangular plastic crates of 60 x 40 x 30 cm^3. PVC pipes of 0.5 inch diameter were used for fabricating these rectangular rafts. Ten polypropylene ropes were tied parallel at 10 cm intervals on these rafts and introduced into the plastic crates (Plate 2). The 50 L plastic crates were filled with 20 L sterile seawater. Salinities tested were 5, 10, 15, 20, 25, 30 and 35 ppt that were chosen to mimic the natural conditions that the seaweed would experience in the natural habitat. Fronds of *G. corticata* weighing 100 g were used as seeding material on rafts. The trials were carried out in triplicates for 30 days by providing a photoperiod of 12:12 (L: D) with continuous aeration using air pumps. The culture crates were also stocked with a known quantity (100 g) of seaweed for determining colour, growth, *etc*.

While natural seawater contains many of the necessary trace elements needed for seaweed culture, the quality and amount of nutrients can be variable and insufficient during the indoor culture. Therefore the sterilized seawater

Growth observed in 20 ppt salinity

Growth observed in 25 ppt salinity

Growth observed in 30 ppt salinity

Growth observed in 35 ppt salinity

was enriched with a concentrated nutrient solution (ammonium sulphate-1.0 gm, urea-0.5 gm, single super phosphate-0.5 gm) once in weekly basis.

Water quality parameters (pH, salinity, temperature, dissolve oxygen, ammonia, phosphate and silicate) of culture water were determined every seven days along with growth measurements during the culture period. The growth measurements were recorded after draining the crates, removing all the dead material and blotting dry the thalli. Gross weight of the seaweed in each crate was also determined. Water was completely replaced during the time of growth measurements at weekly intervals. Before refilling the crates, it was scrub cleaned using fresh water, rinsed thoroughly and filled with water of appropriate salinity.

Fastest thalli growth was recorded in crates containing full strength seawater (35 ppt) and successively slowed down in crates with lower salinities. The low salinity samples showed signs of deleterious effects on seaweed growth. The thalli turned white and dead tissue were visible in areas where the thalli was damaged. After the second week of culture, the thalli began to show a green tinge in lower salinities as opposed to dark red colour at higher salinities. During the trial, treatments with higher salinity showed growth in the form of branching with growth of new thalli at apices and all along the thalli. Growing apices were lighter in colour and tended to be light to deep red.

After five days of culture period bleaching and infestation with green algae were observed in *G. corticata* maintained at 5-15 ppt salinity. Plants could barely survive below 10 ppt, with very low daily growth rate. Increase in weight gain was observed from 20 to 35 ppt salinity. After 30 days of culture period, mean weight of seaweed harvested from each treatment was 108±8.5 g (20 ppt), 155±12.5 g (25 ppt), 156±10.2 g (30 ppt) and 160±12.8g (35 ppt) (Fig.1). There was no significant difference between the final growth of *G. corticata* in 25, 30 and 35 ppt salinities. Earlier studies reported mean growth for *G. corticata* at different seasons. A 90 days culture with initial seed material of 500 g during winter season (October-December) recorded 1058.70 ± 63.82 g and during summer season (February-April) 1248.82 ± 80.75 g by raft method. Similarly a mean daily growth

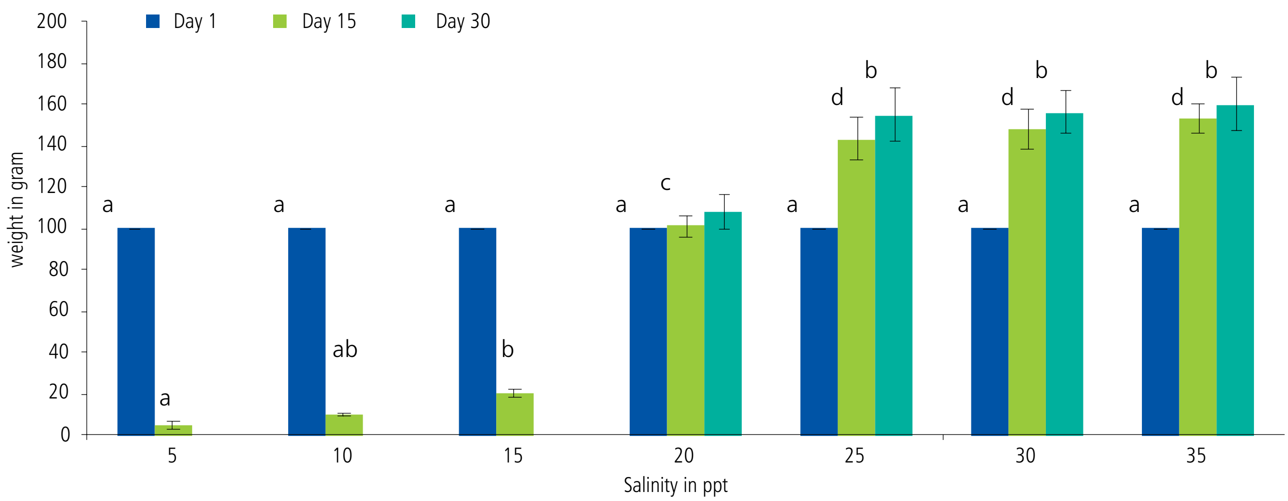

Fig.1. Mean growth rate of *Gracilaria corticata* in different salinity during 30 days culture

Table 1. Water quality parameters during 30 days experimental trials:

	WEEK I							WEEK II							WEEK III							WEEK IV						
SALINITY (ppt)	5	10	15	20	25	30	35	5	10	15	20	25	30	35	5	10	15	20	25	30	35	5	10	15	20	25	30	35
TEMPERATURE (ºC)	28	28	28	28	28	28	28	-	-	-	26	26	26	26	-	-	-	27	27	27	27	-	-	-	29	29	29	29
PH	8.4	8.2	8.4	8.3	8.6	7.9	8.4	-	-	-	8.2	8.2	8.1	8.1	-	-	-	8.3	8.3	8.2	8.0	-	-	-	8.4	8.2	8.0	8.0
ALKALINITY (ppm)	156	148	150	144	132	124	126	-	-	-	146	132	120	122	-	-	-	132	140	130	136	-	-	-	146	132	106	122
DO (ppm)	7.1	7.2	7.3	7.4	7.5	7.4	7.3				7.4	7.3	7.1	7.2				6.9	7.0	7.0	6.8				7.0	7.1	7.3	7.2
AMMONIA (ppm)	0.7	0.6	0.8	0.7	0.8	0.9	0.8	-	-	-	0.4	0.4	0.5	0.5	-	-	-	0.3	0.3	0.1	0.1	-	-	-	0.2	0.1	0.1	0.1
SILICATE (ppm)	3.9	3.4	3.7	2.9	2.8	2.7	2.0	-	-	-	2.1	0.9	0.5	0.4	-	-	-	2.7	1.7	1.2	1.1	-	-	-	2.3	1.5	1.1	0.9
PHOSPHATE (ppm)	0.7	0.6	0.7	0.6	0.6	0.6	0.6	-	-	-	0.6	0.5	0.4	0.4	-	-	-	0.5	0.5	0.4	0.3	-	-	-	0.4	0.4	0.3	0.3

rate (DGR %) of 0.95, 0.707 and 0.799 during winter and 1.52, 1.38 and 1.24 during summer was reported for raft method, polythene bag method and long-line method respectively indicating that the raft method is the best in both seasons when compared to other methods (Tandel *et al*., 2017). In the present study, the mean daily growth rate (%) observed for *G. corticata* was 0.25 (20 ppt), 1.46 (25 ppt), 1.48 (30 ppt) and 1.56 (35 ppt). DGR of 1.56 (35 ppt) is almost similar to the previous report of 1.52 during the summer season for 90 days culture (Tandel *et al.,* 2017). The present trials confirm that *G. corticata* can be cultured using raft method at salinity above 25 ppt.

The water quality parameters measured weekly also shows reduction in the level of nutrients like ammonia, silicate and phosphate (Table 1) as the culture progressed that indicated nutrient utilisation. In coastal as well as in estuarine waters, high levels of nutrient load can trigger harmful algal blooms and contribute to excessive growth of unwanted macrophytes, which in turn have serious negative consequences on coastal ecosystems and the economy. These nutrients could instead be used to support the growth of economically important seaweeds. *G. corticata* can be incorporated in small-scale integrated multi-trophic aquaculture (IMTA) for effective nutrient extraction from the farming system to reduce the excess nutrient load in the ecosystem. Trials conducted indicate the suitability of *G. corticata* in IMTA in estuarine as well as coastal waters. Further field trials in IMTA would prove its feasibility in nutrient load reduction in the estuarine as well as coastal waters.

Reference:

Tandel K. V. *et al.,* 2017. *Eco. Env. & Cons*., 23 (2): 837-842.