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Effect of different fertilizers on the growth of *Gracilaria edulis* (Gmelin) silva in onshore cultivation

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ABSTRACT

Culture of agar yielding red alga *Gracilaria edulis* was carried out using fiberglass tanks in onshore condition under a shed with transparent roof and providing running seawater system and aeration. The seed material was pretreated for 12 hours at different concentrations of Urea, NPK, Superphosphate, Di-ammonium phosphate, Ammonium sulphate, Organic fertilizer, Organic mixture, Potash, Ammonium Chloride, Calcium nitrate, Magnesium sulphate and Ferrous sulphate. In general, the growth and biomass of cultured seaweed were found to be more in plants treated with low concentrations of these fertilizers than untreated and plants treated with higher concentrations. Data on the environmental and hydrological parameters from seaweed culture tanks were recorded.

Introduction

In India bacteriological grade agar is manufactured from *Gelidiella acerosa* and food grade agar from *Gracilaria edulis*. There are about 25 agar industries situated in the maritime states of Tamil Nadu, Karnataka and Kerala. Among these industries more than 20 industries are producing food grade agar utilizing *Gracilaria edulis* as raw material. During the years 1978 to 2003, 108 to 974 tons of *Gracilaria edulis* raw material exploited per year from wild were utilized for the production of food grade agar (Kaliaperumal *et.al.*, 2004). The natural resource of *G.edulis* is not adequate to meet the raw material requirement of the Indian agar industries. In order to augment the resources and maintain uninterrupted supply of this red alga, experimental and pilot scale cultivation was attempted by several workers under different environments (Raju and Thomas, 1971; Umamaheswara Rao,1974; Krishnamurthy, *et.al.*, 1975 and 1977; Chennubhotla, *et.al.*, 1978 and 1992; Kaliaperumal *et.al.*, 1992, 1993, 1996 and 2003 a).

Though these culture experiments revealed that *Gracilaria edulis* could be cultivated successfully on commercial scale, there were failures of crops in certain periods due to various environmental factors such as low light intensity, water turbidity, sedimentation and biological factors such as grazing by fishes, epiphytes and epifauna (Kaliaperumal *et.al.*, 1993). Some information is available on the onshore culture of *G.edulis* (Hemalatha and Rengasamy, 1999; Kaliaperumal *et.al.*, 2003 b and 2003 c). In order to get consistent crops with better yield and quality of the finished product, the present study to culture the agar yielding red alga *Gracilaria edulis* in the onshore shed was undertaken by pretreating the seed material with different fertilizers namely urea, NPK, super phosphate, di-ammonium phosphate, ammonium sulphate, organic fertilizer, organic mixture, potash, ammonium chloride, calcium nitrate, magnesium sulphate and ferrous

sulphate. The results obtained are presented and discussed.

Materials and Methods

Gracilaria edulis (Gmelin) Silva was cultured by vegetative propagation method in 1000 l capacity fiberglass tanks kept in onshore shed covered with light transparent roof providing continuous running seawater and aeration. Healthy plants of *G.edulis* collected from the subtidal region at Thonithurai near Mandapam were brought to the laboratory in plastic buckets containing seawater. They were cut into about 6 cm fragments and used as seed material. Experiments were conducted by pretreating the seed material with different concentrations (ranging from 10 to 50 mg/l) of urea, NPK, super phosphate, di-ammonium phosphate, ammonium sulphate, organic fertilizer, organic mixture, potash, ammonium chloride, calcium nitrate, magnesium sulphate and ferrous sulphate and by broadcasting the treated seed material at the bottom of the tanks. Control experiments without treatment were also maintained. The water level maintained in all tanks was 45 cm. These experiments were conducted for a period of 35-50 days each time between February 1999 and February 2004.

Results

Data collected on the biomass of *G.edulis* cultured after pretreating the seed material with 10,20,30,40 and 50 mg/l concentrations of urea, NPK and super-phosphate for 12 hours are given in Fig.1. Maximum increase in yield of 116% over control for urea, 165% with 20 mg/l concentration for NPK and 100% with 10 mg/l concentration for super phosphate were obtained. In the plants pretreated with 10,20,30,40 and 50 mg/l concentrations of di-ammonium phosphate, ammonium sulphate and organic fertilizer, the percentage increase in yield was found to be high at 10 mg/l concentration with di-ammonium phosphate (156%) and ammonium sulphate (150%) and at 40mg/l concentration with organic fertilizer (100%) (Fig. 2).

Results obtained on the biomass of *G. edulis* by pretreating the seed material with 10,20,30,40 and 50 mg/l concentration of organic mixture, potash and ammonium chloride are shown in Fig.3. More increase in yield at 30 mg/l concentration with organic mixture (74%) and potash (66%) and at 10 mg/l concentration with ammonium chloride (24%) were recorded. Fig.4 shows the biomass of *G.edulis* after pretreating the seedlings at 10, 20, 30 and 40 mg/l concentrations of calcium nitrate, magnesium sulphate and ferrous sulphate. Maximum percentage in yield with all concentrations was obtained with calcium nitrate (16%) and magnesium sulphate (15%) whereas maximum increase in yield of 26% was recorded at 40 mg/l concentration for ferrous sulphate. Variations in the environmental and hydrological parameters in the seaweed culture tanks during the study period are presented in Table 1.

Discussion

During the field cultivation of *G.edulis* in the nearshore areas of Gulf of Mannar and Palk Bay, epiphytes, epifauna, sedimentation and grazing by fishes were found to hamper the growth resulting in failure of crop during some seasons (Kaliaperumal *et.al.*, 1993 and 2003a). The present investigation reveals that these constraints can be overcome in the onshore cultivation and consistant crop could be obtained throughout the year. The present study also shows that application of fertilizer in low concentrations promotes the growth and production of cultured seaweed. This conforms to the results obtained by Kaliaperumal *et.al.* (2003 b) on the outdoor culture of *G.edulis* by providing the seed material with different quantities of NPK, urea, ammonium sulphate, sodium phosphate, potassium nitrate,

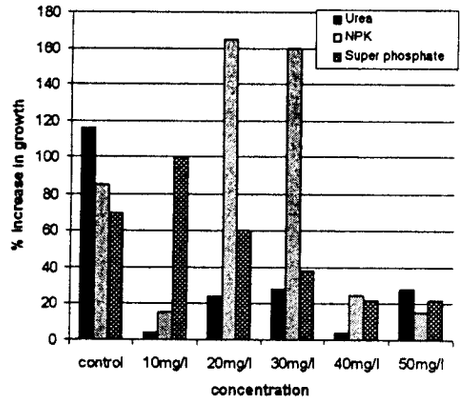

Fig. 1. Biomass of *Gracilaria edulis* preteated for 12 hours at different concentrations of Urea (30 days growth), NPK (35 days growth) and Superphosphate (40 days growth).

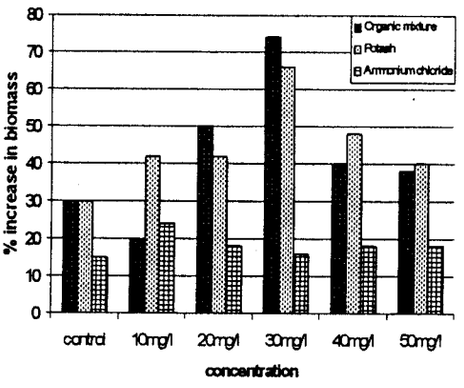

Fig. 3. Biomass of *Gracilaria edulis* preteated for 12 hours at different concentrations of Organic mixture (40 days growth), Potash (40 days growth) and Ammonium chloride (45 days growth).

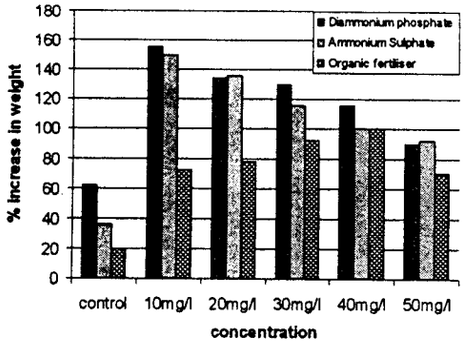

Fig. 2. Biomass of *Gracilaria edulis* preteated for 12 hours at different concentrations of Diammonium phosphate (30 days growth), Ammonium sulphate (35 days growth) and Organic fertiliser (40 days growth).

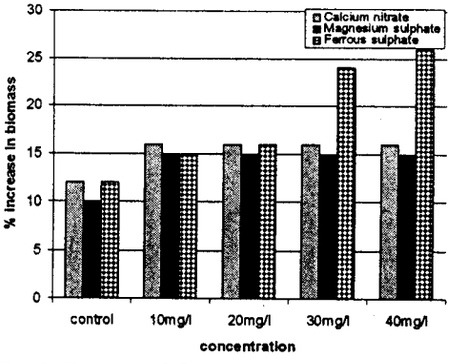

Fig. 4. Biomass of *Gracilaria edulis* preteated for 12 hours at different concentrations of Calcium nitrate (40 days growth), Magnesium sulphate (40 days growth) and Ferrous sulphate (40 days growth).

phosphate and EDTA. The growth and biomass obtained for *G edulis* with fertilizers in the present investigation can be equally compared with the results obtained in the field culture experiments of this species in Krusadai Island lagoon (Raju and Thomas, 1971; Krishnamurthy *et.al.*, 1975 and 1977), in Mandapam and Rameswaram area (Umamaheswara Rao, 1974; Chennubhotla *et.al.*, 1978; Kaliaperumal *et.al.*; 1993,2003a) in Valinokkam Bay (Kaliaperumal *et.al.*, 1996) and in Minicoy lagoon (Kaliaperumal *et.al.*, 1992; Chennubhotla *et.al.*, 1992). Pilot scale onshore culture of seaweed is necessary to perfect the technology for the benefit of seaweed industry and private entrepreneurs.

Table 1. Data collected on environmental and hydrological parameters from the culture shed during February 1999 to February, 2004

Parameters	Minimum value	Maximum value
Atmospheric temperature (°C)	25.0	37.2
Culture shed temperature (°C)	25.5	37.6
Water temperature in tanks (°C)	25.5	36.4
Light intensity (lux)	< 100	6600
pH	7.5	8.8
Salinity (‰)	27.5	35.5
Dissolved oxygen (ml/l)	3.4	6.6

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