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Effect of growth promoters on the onshore culture of *Gracilaria edulis* (Gmelin) Silva

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ABSTRACT

Culture of agar yielding red alga *Gracilaria edulis* was carried out in fibreglass tanks by providing running seawater and aeration under a shed with transparent roof. The seed material was pretreated for 12 hours at different concentrations of growth promoters IAA, IBA, GA, Ascorbic acid, EDTA and Inositol. In general, more increase in growth and biomass was obtained in the plants pretreated with lower concentrations of these growth promoters.

Introduction

In India, the red algae *Gelidiella acerosa* is being used more for the production of bacteriological grade agar and *Gracilaria edulis* for the food grade agar. Out of the 25 agar industries functioning in the maritime states of Tamil Nadu, Karnataka and Kerala, more than 20 industries are utilising *Gracilaria edulis* as raw material. During the years 1978 to 1999, 108 to 974 tons of *G. edulis* resources exploited per annum from the wild were apparantly utilised for the manufacture of the food grade agar (Ramalingam *et. al.*, 2000). The natural seaweed beds of Tamil Nadu coast are 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 field 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 and 1996).

Although *Gracilaria edulis* could be cultivated successfully on commercial scale, failure of crop production in certain periods occurred due to various environmental factors such as low light intensity, water turbidity and sedimentation and biological factors such as grazing by fishes, epiplytes and epifauna (Kaliaperumal *et. al.*, 1993). With a view to obtain consistant crop with more yield, 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 concentrations of growth promoters such

as Indole acetic acid, Indole butyric acid, Gibbrellic acid, Ascorbic acid, Ethylene Diamine Tetra Acetic acid (EDTA) and Inositol. The results obtained are presented and discussed.

Materials and Methods

Gracilaria edulis (Gmelin) Silva was cultured by vegetative propagation method in 1000 litre capacity fibreglass tanks located on onshore shed covered with light transparent roof providing continuous running seawater and aeration. Healthy plants of *G. edulis* were collected from the subtidal region at Thonithurai near Mandapam coast and brought to the laboratory in plastic buckets containing seawater. They were cut into about 6 cm fragments and used as the seed material. Experiments were conducted by pretreating the seed material with different concentrations of IAA, IBA, GA, Ascorbic acid, EDTA and Inositol for 12 hours and by broadcasting the treated seed material uniformly at the bottom of the tanks. Control experiments without any treatment were also maintained. The water level monitored in all tanks was 45 cm. These experiments were conducted for a period varying from 22 to 37 days.

Results

Data obtained on the growth and biomass of *Gracilaria edulis* cultured after pretreating the seed material with 0.1, 0.2, 0.3, 0.4, 0.5 and 0.6 mg/l concentrations of Indole acetic acid for 12 hours are given in Table 1. Maximum percentage increase in yield of 86% after 30 days of culture period was recorded in the plants treated with 0.1 mg/l concnetration than in the plants treated with other concentrations and control. The plants pretreated with 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7 and 0.8 mg/l concentrations of Indole 3-Butyric acid for 12 hours, the percentage increase in yield was found to be high (80%) after 30 days of growth when compared with the plants pretreated with all other concentrations as well as in the control (Table 2).

Data collected on the growth and biomass of *Gracilaria edulis* by pretreating the seed material with 0.05, 0.1, 0.2, 0.3 and 0.4 mg/l concentrations of Gibberellic acid are shown in Table 3. More increase in yield (160%) was recorded after 22 days of growth in the plants pretreated with 0.05 mg/l concentration than in other treatments and control (Table 3). In the plants pretreated with 10, 20, 30, 40, 50, 60 and 70 mg/l concentrations of Ascorbic acid for 12 hours, the plants treated with 10 mg/l concentration showed maximum biomass of 88% after 36 days of culture period than in other treatments and control (Table 4).

Table 5 shows the growth and biomass of *G. edulis* after pretreating the seedlings with 1, 2, 3, 4, 5, 6 and 7 mg/l concentration of EDTA for 12 hours. Maximum percentage increase in yield of 114% was registered in the plants pretreated with 1.0 mg/l concentration after 37 days of culture period than in other concentrations and control. Table 6 shows the results obtained on the growth and biomass of *G. edulis* after pretreatment with 1, 2, 3, 4, 5 and 6 mg/l concentrations of Inositol. Maximum increase in yield (80%) was found after 30 days of culture period in the plants treated with 2 mg/l threshold concentration than in other concentrations and control.

Discussion

The growth promoters play a major role in the regulation of plant growth. The Indole acetic acid at low concentrations stimulated the growth in *Fucus evanescens, Ascophyllum nodosum* and

Table 1. *Growth (30 days) and biomass of cultured* Gracilaria edulis *by pretreating the seed materials with diferent concentration of Indole Acetic acid for 12 hours*

Concentration of IAA (mg/l)	Quantity of seed material introduced (fr. wt. in kg)	Quantity harvested (fr. wt. in kg)	% increase in yield	% increase in wt. / day
Control	1.000	1.850	85	2.8
0.1	0.250	0.465	86	2.9
0.2	0.250	0.445	78	2.6
0.3	0.250	0.430	72	2.4
0.4	0.250	0.425	70	2.3
0.5	0.250	0.415	66	2.2
0.6	0.250	0.415	66	2.2

Table 2. *Growth (30 days) and biomass of cultured* Gracilaria edulis *by pretreating the seed materials with diferent concentration of Indole-3-Butyric acid for 12 hours*

Concentration of IBA (mg/l)	Quantity of seed material introduced (fr. wt. in kg)	Quantity harvested (fr. wt. in kg)	% increase in yield	% increase in wt. / day
Control	0.250	0.430	72	2.4
0.1	0.500	0.900	80	2.7
0.2	0.500	0.820	63	2.1
0.3	0.500	0.720	44	1.5
0.4	0.500	0.700	40	1.3
0.5	0.500	0.680	36	1.2
0.6	0.250	0.400	60	2.0
0.7	0.250	0.360	44	1.5
0.8	0.250	0.325	30	1.0

Table 3. *Growth (22 days) and biomass of cultured* Gracilaria edulis *after pretreating the seed materials with diferent concentration of Gibberellic acid for 12 hours*

Concentration of GA (mg/l)	Quantity of seed material introduced (fr. wt. in kg)	Quantity harvested (fr. wt. in kg)	% increase in yield	% increase in wt. / day
Control	0.200	0.450	125	5.7
0.05	0.200	0.520	160	7.3
0.1	0.200	0.420	110	5.0
0.2	0.200	0.400	100	4.5
0.3	0.200	0.400	100	4.5
0.4	0.200	0.350	75	3.4

Table 4. *Growth (36 days) and biomass of cultured* Gracilaria edulis *after pretreating the seed materials with diferent concentrations of Ascorbic acid for 12 hours*

Concentration of Ascorbic acid (mg/l)	Quantity of seed material introduced (fr. wt. in kg)	Quantity harvested (fr. wt. in kg)	% increase in biomass	% increase in wt. / day
Control	1.000	1.800	80	2.2
10	0.250	0.470	88	2.4
20	0.250	0.420	68	1.9
30	0.250	0.400	60	1.7
40	0.250	0.400	60	1.7
50	0.250	0.375	50	1.4
60	0.250	0.300	20	0.6
70	0.250	0.300	20	0.6

Table 5. *Growth and biomass of cultured* Gracilaria edulis *after pretreating the seed materials with diferent concentrations of Ethylene Diamine Tetra Acetic acid for 12 hours*

Concentration of EDTA (mg/l)	Quantity of seed material introduced (fr. wt. in kg)	Number of days of growth	Quantity harvested (fr. wt. in kg)	% increase in yield	% increase in wt. / day
Control	1.000	37	1.700	70	1.9
1.0	1.000	37	2.140	114	3.1
2.0	0.250	30	0.460	84	2.8
3.0	0.250	30	0.375	50	1.7
4.0	0.250	30	0.460	84	2.8
5.0	0.250	30	0.460	84	2.8
6.0	0.250	30	0.450	80	2.7
7.0	0.250	30	0.410	64	2.1

Table 6. *Growth (30 days) and biomass of cultured* Gracilaria edulis *by pretreating the seed material with diferent concentration of Inositol*

Concentration of Inositol (mg/l)	Quantity of seed material introduced (fr. wt. in kg)	Quantity harvested (fr. wt. in kg)	% increase in yield	% increase in wt. / day
Control	1.000	1.600	60	2.0
1 mg/l	0.250	0.375	50	1.7
2 mg/l	0.250	0.450	80	2.7
3 mg/l	0.250	0.400	60	2.0
4 mg/l	0.250	0.390	56	1.9
5 mg/l	0.250	0.400	60	2.0
6 mg/l	0.250	0.390	56	1.9

Gracilaria corticata (Davidson, 1950). The gibberellin gave positive response in *Ulva* (Provasoli, 1957). In the field cultivation of *Gracilaria edulis* by pretreating the seed material with 5 mg/l and 10 mg/l concentrations of IAA, GA, Kinetin, 2-4 D Sodium salt and Maleic hydrazide, Kinetin at 10 mg/l concentration produced maximum increase in length of plants (Paramasivam and Devadoss, 1985). In the study made by Hemalatha and Rengasamy (1999), growth of *G. edulis* increased when it was treated with low concentrations of IAA, gibberellin and kinetin. The apical fragments of *Gracilaria corticata* treated with lower concentrations (10^{-4M} to 10^{-12M}) of IAA progressively showed stimulated growth as indicated by linear measurement and dry weight and high concentration (10^{-2M}) was found lethal (Oza, 1971). The growth of *Sargassum swartzii* was enhanced when it was treated with auxin at 10^{-5M} of treatment (Chauhan and Joshi, 1985). Gibberellin in low concentration promoted the growth of *Enteromorpha, Ecklonia* (Jennings, 1968) and of *Gelidiella accrosa* in laboratory culture (Dutta *et. al.*, 1990).

Similarly low concentration of kinetin enhanced the growth of conchocelis phase of *Porphyra* (Iwasaki, 1965) and *Gracilaria corticata* (Subbaraju et. al., 1981). The fresh weight and number of proliferation increased in *Gelidiella acerosa* (Tewari, 1975) when it was treated with morphactin (chloroflurenol). In *Gelidiella acerosa* treated with 100 mg/l concentration of ascorbic acid, kinetin and napthalene acetic acid, 300 g/m^2 seed material yielded 650 g/m^2 (annual yield) with ascorbic acid and kinetin (Subbaramaiah and Thomas, 1989). In the present study, growth of *G. edulis* was promoted when treated with low concentrations of IAA, IBA, GA, Assorbic acid, EDTA and Inositol. The results obtained in this investigation have the potential to increase crop production.

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