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TAXONOMICAL REVISION AND SOME BIOLOGICAL OBSERVATIONS ON SCYTOSIPHONALES (PHAEOPHYTA) OF KARACHI COAST

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Abstract

Taxonomy, morpho-anatomy and some biological notes of 4 genera with 6 species viz., *Colpomenia sinuosa* (Mertens ex Roth) Derbes & Solier; *Igengaria stellata* (Bòerg.) Boergesen; *Rosenvingia fastigiata* (Zanardini) Boergesen, *R. orientalis* (J. Agardh) Boergesen; *Hydrocla thrus clathratus* (C. Agardh) Howe including one new record of *Colpomenia ecuticulata* Parson of Scytosiphonales from Karachi coast is pre sented.

Introduction

The dominating benthic algal group Phaeophyceae is represented by 17 genera and 48 species on Karachi coast (Begum & Khatoon, 1988) and 20 genera and 28 species on Lasbela coast (Shameel, 1987, 1989). Out of these 4 genera and 6 species belong to the order Scytosiphonales (Punctariales). The taxonomy of the order Scytosiphonales was for the first time reported as Punctariales by Nizamuddin & Begum (1978). During the survey of brown algal flora from 1982-1986 (Begum & Khatoon, 1988) and from 1986-1990 specimens have been abundantly collected and detailed morpho-anatomical observations were made which were compared with previous workers. The present study reports some additional vegetative and reproductive characters of 5 species of the Scytosiphonales and also adds one new record *Colpomenia ecuticulata* Parson from Karachi coast. The systematic position was followed according to the recent classification by Womersely (1987). The biological observations has also been made which provided the knowledge about their distribution, time of occurrence, abundance and periodicity in growth and reproduction.

Materials and Methods

For taxonomical studies observations were made as previously reported by Khatoon & Begum (1990). The morphological, anatomical and reproductive characters as reported by previous workers (Nizamuddin & Begum 1978) has not been described in the text.

To determine the seasonal variations in occurrence, abundance and periodicity in growth and reproduction, 10-20 populations from different ecological conditions were collected to cover most of the coastal area. Abundance has been noted by counting the number of plants in each month and then recording the period of maximum and minimum number of plants. Seasonal variations in growth has been noted by measuring the thallus length in each month, the number of fertile plants was counted to note the maximum and minimum fertility period and also indicating the kinds of reproductive organ.

NOTES OF TAXA

Scytosiphonales Feldmann

Scytosiphonaceae Farlow

Colpomeni sinuosa (Mertens ex Roth) Derbes *et* Solier (Fig.1. A-E).

Boergesen 1914:176; 1934:25; 1935:34; 1939:89; 1948:49. Lucas 1936: 103. Smith 1944:128. Nasr 1947:7. Fritsch 1952:109. Taylor 1960:260. Durairatnam 1961:32. Misra 1966:115. Nizamuddin & Begum 1978:318. Parson 1982:291. Shameel 1987:513. Silva *et al.* 1987:80. Womersley 1987:297. Begum & Khatoon 1988:300.

Thallus morphology is similar to the previous report by Nizamuddin & Begum (1978) but size of the thallus ranges from 0.5-40 cm, sterile thallus is small (0.5-1 cm), yellowish brown when dried, but fertile thallus is large (1.5-40 cm) and reddish to blackish brown.

In surface view, cells are different in shape and size on both surfaces. Dorsal surface of the thallus with small, quadratic or polygonal cells, all with single phaeoplast; ventral surface with large and irregular cells, only few cells with single phaeoplast. These characters has been illustrated only by figures by previous workers.

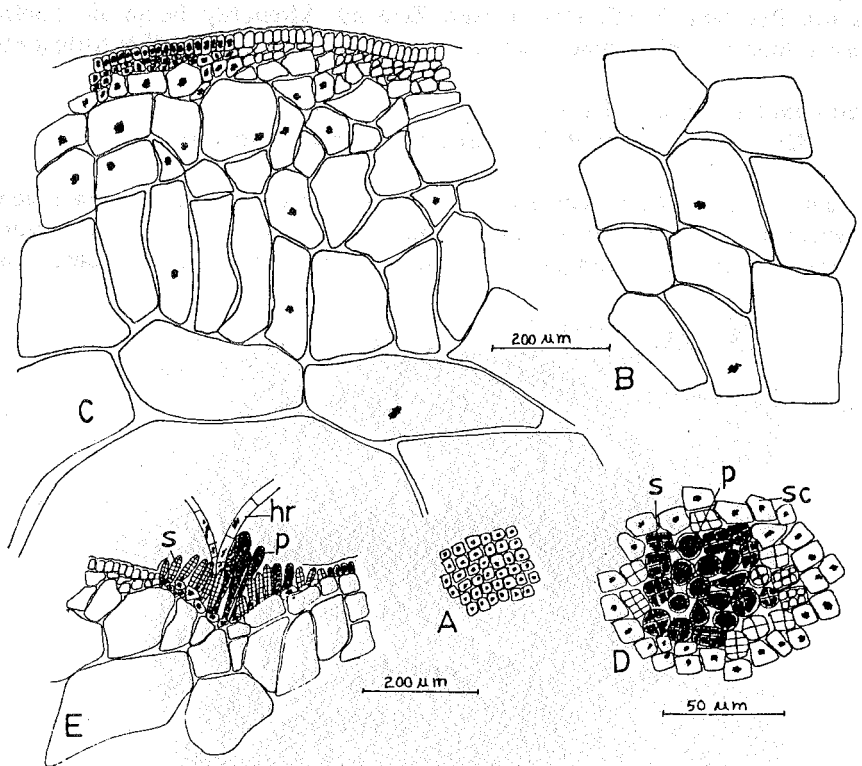

Fig.1. A-E. *Colpomenia sinuosa* (Mertens ex Roth) Derbes & Solier: A. Upper surface cells; B. Lower surface cells; C. T.S. of thallus showing three typs of medullary cells; D. Surface view showing paraphyses surrounded by plurilocular sporangia; E. T.S. of the thallus with sporangia, hairs and paraphyses.

In T.S. thallus 6-8 (-9) layered; medullary region composed of three different types of cells; 1-2 outer layers of small polygonal cells, 45 μm in diameter; middle 2-3 layers of polygonal or radially elongated cells, 120 μm in diameter; inner most 1-2 layers of large irregular or periclinally elongated cells 165 μm in diameter. Intercellular spaces present. The present observations differ from the previous report in much thicker plants 6-8 layered than 6 layered and medulla differentiated into three parts not into two parts and intercellular spaces present in between medullary cells.

Paraphyses and hairs both present in the middle of each sorus, hairs occasionally seen in sori of older thallus. Plurilocular sporangia biseriate when young become uniseriate when old.

Local distribution: Manora (Leg. M. Begum & N. Khatoon, 1.11.1982; 16.11.1982; 1.12.1982; 16.12.1982; 19.12.1982; 5.2.1983; 17.1.1984; 11.2.1984; 5.3.1984; 8.4.1984; 4.5.1984; 21.3.1985; 3.2.1986; 12.1.1988; 5.2.1989; 16.2.1990) Hawkes Bay (Leg. M. Begum & N. Kha toon, 31.3.1982; 4.4.1985. N.Khatoon, 9.4.1982. M. Begum, 21.11.1986; 4.2.1990) Buleji (Leg. M. Begum & N. Khatoon, 31.3.1982; 12.5.1982; 26.1.1983; 7.3.1987. M. Begum, 13.1.1990) Paradise Point (Leg.N. Khatoon, 9.4.1982. M. Begum, 15.3.1990).

Geographical distribution: Arabian Sea; Ceylon, Mauritius, Persian Gulf, Karachi (Pakistan); Red Sea; Pacific Ocean: New Zealand, Monterey Peninsula, Southern California, Australia, Philippines; Mediterra nean Sea: Europe as well as African coast.

C. ecuticulata Parson Fig.2, Fig.3. A-C.
Parson 1982:297. Womersely 1987:298. Begum & Khatoon 1988:300.

Thallus mostly small, 9 cm in diameter thin, globular, much lobed, hollow filled with water, greenish to brown in colour, loosely attached by a broad base. Cells of dorsal and ventral surfaces and the arrangement and shape of medullary cells are same as in *C. sinuosa*.

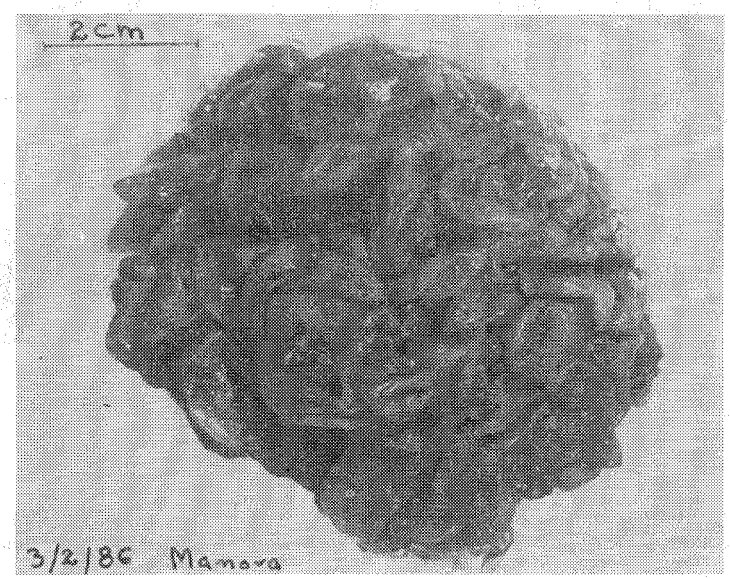

Fig.2. Habit of the plant (*Colpomenia ecuticulata* Parson).

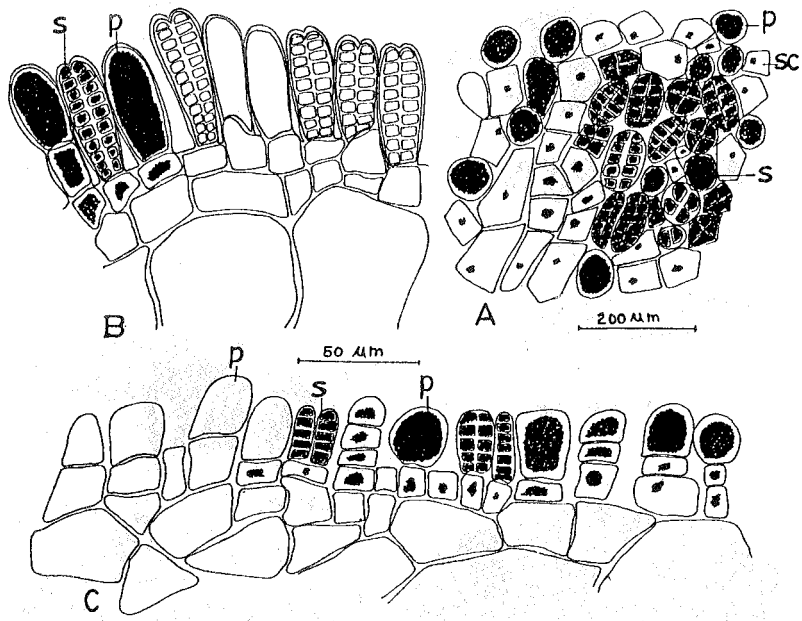

Fig.3. A-C. *Colpomenia ecuticulata* Parson: A Surface view showing scattered paraphyses and plurilocular sporangia; B. T.S. of thallus with plurilocular sporangia and paraphyses; C. T.S. showing developing 2-4 celled paraphyses and sporangia.

Thallus 5-7 layered, 270 μm thick, assimilatory cells single layered, squarish in shape, with dense phaeoplast, 10 μ in diameter; medullary cells 4-6 layered, outer cells upto 50 μm in diameter, middle cells 100 μm and inner most cells 150 μm in diameter.

In surface view plurilocular sporangia round to oval in shape, bi to multiseriate; paraphyses large, reddish brown in colour, irregularly scattered and round in shape. In T.S. sporangia 20 μm high, 5 μm broad; paraphyses 1-3 (-4) celled, 20 μm high, 8 μm broad; indusium absent. Hairs rarely seen.

Local distribution: Manora (Leg. M. Begum & N. Khatoon, 5.2.1983; 3.2.1986; 21.1.1988. 23.5.1988) Buleji (Leg. M. Begum, 31.3.1982. M. Begum & N. Khatoon, 26.1. 1983; 7.3.1987).

Geographical distribution: New Zealand; South Australia; Karachi (Pakistan).

This species is reported for the first time from the coast of Karachi (Pakistan). Karachi specimens resemble to the type specimens described by Parson (1982) from New Zealand and also Womersley (1987) from South Australia, but differs with the latter in smaller sized thallus.

This species is distinguished from *C. sinuosa* due to smaller sized and thin thallus, thallus much lobed, less number of layers of medullary cells, hairs and paraphyses scattered and present in the sorus, paraphyses septate.

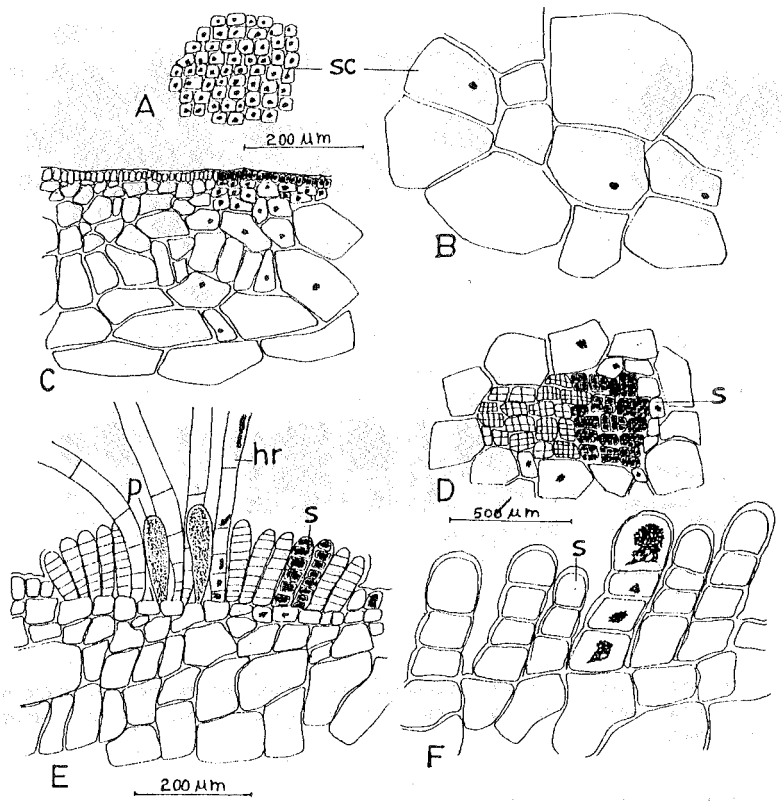

Fig.4. A-F. *Iyengaria stellata* (Bòerg.) B òergesen: A. Upper surface cells; B. Lower surface cells; C. T.S. of thallus showing three dif ferent types of the cells; D. Surface view showing plurilocular spo rangia; E. T.S. of the thallus showing plurilocular sprorangia, paraphyses and hairs in middle of the sorus; F. T.S. showing developing sporangia.

Iyengaria stellata (Bòerg.) Bòergesen Fig.4. A-F.

Bòergesen 1939:91. Fritsch 1952:111. Nizamuddin & Gessner 1970:6. Misra 1966:118. Nizamuddin & Begum 1978:316. Shameel 1987:513. Begum & Khatoon 1988:301.

The dorsal and ventral surface cells are similar in structure as in *Colpomenia*. Thallus 6-8 layered, medullary region consist of 3 types of cells. Inner most 1-2 layers of irregular and periclinally elongated cells, 120 μm broad, 65 μm high; middle 2-3 layers of polygonal cells, 53 μm in diameter; outer most layer of small cells 26 μm in diameter. Intercellular spaces present. Hairs and paraphyses if present arise from middle of the sori which was not previously observed. Sporangia 20 μm high, 8 μm broad; hairs 18 μm broad; paraphyses 25 μm high, 10 μm broad; sori indusiate.

Local distribution: Manora (Leg. M. Begum & N. Khatoon, 31.3.1982; 1.11.1982; 16.11.1982; 20.11.1982; 1.12.1982; 16.12.1982; 19.12.1982; 5.2.1983; 17.1.1984; 11.2.1984; 5.3.1984; 8.4.1984; 4.5.1984; 3.2..1986; 12..1.1988; 5.2.1989; 16.2.1990) Hawkes Bay (Leg.M. Begum & N. Khatoon, 31.3.1982. N. Khatoon, 9.4.1982. M. Begum, 21.11.1986; 4.2.1990) Buleji (Leg. M. Begum & N. Khatoon, 31.3.1982; 12.5.1982; 26.1.1983; 7.3.1987.

M. Begum, 13.1.1990) Paradise Point (Leg. N. Khatoon, 9.4.1982. M.Begum, 15.3.1990) Cape Monze (Leg.M. Nizamuddin, 20.11.1964).
Geographical distribution: Arabian Sea: Dwarka (India), Karachi (Pakistan), Persian Gulf, False Bay, Messel Bay, Port Alfred.

Rosenvingia fastigiata (Zanardini) Bòergesen Fig.5. A-C.

Boergesen 1914:183. Nizamuddin & Begum 1978:328. Begum & Khatoon 1988:301.

Thallus dichotomously, sub-dichotomously and irregularly branched, apex bifid acute or narrowly rounded. Dorsal surface with small quadratic and angular cells, with single parietal phaeoplast. Ventral surface with large irregular and elongated cells, rarely with phaeoplast. Surface cells of both upper and lower surfaces were not previously observed but are similar as in *Colpomenia*. Intercellular spaces present among the medullary cells.
Local distribution: Manora (Leg. M. Begum & N. Khatoon, 11.2.1984; 4.4.1985; 12.1.1988) Buleji (Leg. M. Begum & N. Khatoon, 26.1.1983).
Geographical distribution: Northern part of Arabian Sea, Karachi (Pakistan); Red Sea.

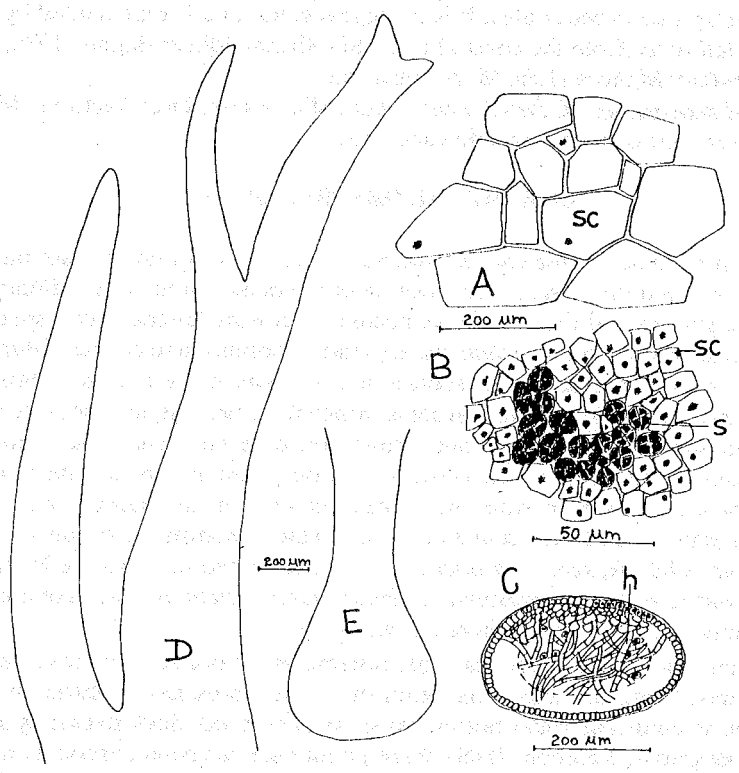

Fig.5. A-C. *Rosenvingia fastigiata* (Zanardini) Bòergesen: A. Lower surface cells; B. Upper surface cells and plurilocular sporangia; C. T,S, of the lower part of the thallus with septate hyphae. D-E. *Rosen vingia orientalis* (J. Agardh) Bòergesen: D. Apical part of branches; E. Hold-fast of thallus. h = hyphae; hr = hair; p = paraphyses; s = sporangia; sc = surface cells.

Rosenvingia orientalis (J. Agardh) Bòergesen Fig.5. D-E.

Boergesen 1914:182; 1930:167. Misra 1966:126. Nizamuddin & Begum 1978:321. Silva *et al.,* 1987:80. Begum & Khatoon 1988: 301.

Thallus distantly irregularly or sub-dichotomously to alternately branched. Dorsal and ventral surface cells are similar to *R. fastigiata*.

Local distribution: Manora (Leg. Fatima, 24.1.1970. M. Nizamuddin, 29.1.1962) Paradise Point (Leg. M. Begum & N. Khatoon, 3.5.1982; 3.2.1986; 5.2.1989).

Geographical distribution: Arabian Sea: Bombay-India; Kalaba shores, Malabar hills, Karachi (Pakistan); Atlantic Ocean: West Indies.

Hydroclathrus clathratus (C. Agardh) Howe

Boergesen 1914:21; 1934:26. Lucas 1936:103. Nasr 1940:12; 1947:72. Durairatnam 1961:33. Joly 1965:91. Taylor 1960:261. Misra 1966:121. Nizamuddin & Begum 1978:321. Silva *et al.,* 1987:80. Womersley 1987:300.

Thallus sessile, first spherical hollow then becoming expanded and flattened, clathrate, margins inrolled. The specimens were not sufficient to make anatomical study. It appears to be a deep water alga. It is a tropical genus and is represented by a single species, *H. clathratus*, from the coast of Karachi (Nizamuddin & Begum, 1978).

Local distribution: Manora (Leg. M. Nizamuddin).

Geographical distribution: Ceylon; South Australia; Philippines; Victoria; Mauritius Island; Eastern part of North America and Brazil.

BIOLOGICAL OBSERVATIONS

The duration of occurrence of each species varied and also showed seasonal changes both in the form and the floristic composition of the plants on the coast (Boney, 1966). Out of three genera and five species collected from Karachi coast, two species *Colpomenia sinuosa* and *Iyengaria stellata* were pseudo-perennial and collected during most of the algal growth period, three species i.e., *Colpomenia ecuticulata, Rosenvingia fastigiata* and *R. orientalis* were annual algae, which were present once or twice in a year.

The comparative distribution and growth on different ecological conditions of different locations such as Manora, Hawkes Bay, Buleji and Paradise Point showed that all 6 species were common with their luxuriant growth on Manora, out of which *Colpomenia sinuosa* and *Iyengaria stellata* are widely distributed on all localities of Karachi coast, while *Rosenvingia orientalis* also distributed on Paradise Point and *C. ecuticulata* and *R. fastigiata* on Buleji but *Hydroclathrus clathratus* was confined to the coast of Manora only (Nizamuddin & Begum, 1978).

The Manora locality not only has wide distribution of floristic composition but also exhibit the most luxuriant algal vegetation due to the presence of different types of habitats such as sandy and rocky bottom pools, sand covered rocks, flat sandy and stony areas etc., (Begum & Khatoon, 1988). Rare population has been observed on Hawkes Bay due to lack of suitable habitats, since most of the area is sandy. Boney (1966) also reported that sandy ground are much less favourable for algal colonisation. The coast of Buleji and Paradise Point comprises of rocky ledge as well as sandy areas.

Colpomenia sinuosa and *Iyengaria stellata* is widely spread all over the localities of Karachi coast, and found to grow on all types of habitats viz., sand covered rocks, sandy and stony bottom pools, flat sandy and stony areas from high to low water mark and also in association with each other. *C. sinuose* was also found to grow on *Stoechospermum marginatum* and *Iyengaria stellata. C. ecuticulata* grows on sand covered rocks and flat sandy areas from high to mid water mark and also grows in association with *C. sinuosa. Rosenvingia fastigiata* and *R. orientalis* were found to grow on flat sandy area from mid to low water mark, but the latter species was also found to grow in association with *Padina pavonia. Hydroclathrus clathratus* is rare along the coast of Karachi since in 20 years time it has been collected only twice from Manora. It is a deeper water alga (Nizamuddin & Begum, 1978).

All the specimens belonging to the order Scytosiphonales were collected during January to May. They were abundant in the month of February due to low temperature and rare in May due to high temperature (Begum & Khatoon 1988). Misra (1966) observed luxuriant growth during November and minimum in May and June from India. Kajimura (1987) working on deep sea flora, collected conspicuous members frequently from early winter to late spring from Japan. Gaur *et al.,* (1982), Pothen *et al.,* (1983), Conver (1958, 1964) reported that the maxima and minima fluctuation in algal population was associated with the temperature and processes of insolation and these play a leading role in seasonal growth of the algae.

Growth of the plants is influenced by the environmental factors. The large sized plants were collected in February and small plants in the month of May. Plants attained their largest size in late winter to early spring. Dawson (1966) also suggested that lower temperature generally favour the development of the marine plants. Furthermore, high precipitation, relative humidity decreases the sea temperature and increases the quantity of dissolved nutrients and consequently enhance the growth of seaweeds in winter. Smaller sized plants were abundant in May as has been reported by Anand (1940) from Manora. This may be related to the exposure of algae to high temperature.

Maximum number of fertile plants were collected during April to May and minimum during November. The same periodicity in fertility in brown algal population has been reported by Begum & Khatoon (1988) from the coast of Karachi. Boney (1966) observed the production of spores during spring and early summer from British Island. Methieson *et al.,* (1976) who worked on Fucoid algae in New England reported the maximum reproduction in spring and minimum in winter months. Edward (1969) reported that the reproductive rate increased with an increase in temperature. Ecological observations however suggested that the fertility of the members of Scytosiphonales increase with increase in temperature, while the size of thallus decreases with increase in temperature. Abundant growth of plant was related with the low temperature in various localities of Karachi coast.

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