



Research Article

HABITAT INFLUENCES THE SEASONAL GROWTH, FRUITING BEHAVIOUR IN SARGASSUM POLYCYSTUM C.AGARDH. (FUCALES, PHAEOPHYCEAE) AT VISAKHAPATNAM COAST, INDIA.

S. B. Padal¹, Danga Appa Rao², Gaddam Subbarangaiah²

¹Government Degree College, Chodavaram, Visakhapatnam 531036, Andhra Pradesh, India

²Department of Botany, Andhra University, Visakhapatnam 530003, Andhra Pradesh, India

Correspondence should be addressed to **S. B. Padal**

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ABSTRACT

Sargassum polycystum C. Ag., is an intertidal algal flora of Visakhapatnam coast. Seasonal growth behaviour was observed throughout the year in the four areas studied i.e., Jodugullapalem, Visakhapatnam, Gangavaram and Pudimadaka in the Visakhapatnam coast for two and half years (December 1995 to May 1998). Young and erect fronds are developed from the perennial holdfast in the month of March/April. Rapid increase in the mean length of erect fronds was observed from May onwards and they attain maximum size in November/December and January. *Sargassum polycystum* analysed from different localities and the mean length of the fronds varied slightly due to variations in the four sites. Plants of sheltered habitat, at Jodugullapalem were taller than those in more exposed habitats at Visakhapatnam and Pudimadaka. The appearance bushiness of these plants also varied in sheltered and exposed habitats. Fruiting plants with receptacles were found seasonally for 3 to 4 months from November to February in *Sargassum polycystum*. The percentage of fruiting plants varied during the fruiting season and maximum number of fertile plants were found in the month of December/January. *Sargassum polycystum* analysed from different localities and the Fruiting plants varied slightly due to variations in the four sites.

KEY WORDS: Seasonal growth, Fruiting behaviour varies, different localities, Visakhapatnam coast, *Sargassum polycystum*.

INTRODUCTION

The species of *Sargassum* are abundant among the brown algae occurring along the Indian shores and these are the chief sources for the extraction of alginic acids in the country (Umamaheswara Rao, 1970). More than 90 species of *Sargassum* have been reported from Indian shores (Srinivasan, 1966). From Visakhapatnam 4 species

of *Sargassum* viz., *S.ilicifolium*, *S.polycystum*, *S.tenerrimum* and *S.vulgare* were reported (Umamaheswara Rao and Sreeramulu, 1970). The above four species have also been found in other localities along the coast of Visakhapatnam.

Sargassum species and other brown algae of the tropical shores are less investigated when compared with ecological, biological and biochemical aspects studied on the members of Laminariales and Fucales of temperate

shores. *Sargassum muticum* species introduced from Japan has received much attention in recent years and many aspects relating to its distribution, growth and development, fruiting behaviour, dispersal and colonization have been studied in details by Fletcher and Fletcher (1975); Norton (1977a,b, 1980 and 1981); Fletcher (1980); and Chritchlez (1980). In other geographical areas also ecological and other investigations on the species of *Sargassum* were made in recent years by Yoshida (1960); Yoshida et al., (1963), Umezaki (1974), Tanuguchi and Yamada (1978) have worked on *Sargassum* species of Japan and De Wreede (1976) and Prince and O'Neal (1979) on *Sargassums* of Hawaii and America respectively.

In view of the importance of brown algae as a source of algin and as food, fodder and fertilizer, special efforts were made in India since 1950 to study the chemical composition and algin content of brown weeds by many workers. Later on, studies were made on the seasonal changes on the extraction of alginic acid contents and on the life cycles of different species of *Sargassum* (Umamaheswara Rao, 1969; Chauhan and Krishnamurthy, 1971; Raju and Venugopal, 1971; Umamaheswara Rao and Kaliaperumal, 1976) growing along the Gujarat, Goa and Mandapam shores. At Visakhapatnam some preliminary observation were made on the seasonal changes in the abundance of brown algae in a general ecological study of the intertidal algae (Umamaheswara Rao and Sreeramulu, 1964; Umamaheswara Rao, 1990). At present, detailed ecological studies on *Sargassum polycystum* occurring in four localities along the Visakhapatnam coast was made for a period of two and half years from December 1995 to May 1998 is presented in this paper.

MATERIALS AND METHODS

Data on the seasonal growth of *Sargassum polycystum* C.Ag. , was collected from December 1995 to May 1998, following the method given by Umamaheswara Rao (1969) for *S.wightii*. Thirty plants of *Sargassum polycystum* C.Ag., were randomly selected from the samples collected from the four field stations viz., Jodugullapalem, Visakhapatnam, Gangavaram and Pudimadaka(Fig.1) (around Visakhapatnam coast) and the mean length of the main shoots and also the lateral branches from the basal holdfast or stem like portion were measured at fortnight intervals. From the data obtained, mean height of the plants or shoots were calculated for each month to show the variation in the growth in different months of the year. While taking the length of the plants, observations were made on their fruiting condition to know the reproductive periods and to estimate the frequency of the plants bearing receptacles in the populations.

RESULTS

Data collected for a period of two and half years from December 1995 to May 1998 on the seasonal growth behaviour in the populations of *Sargassum polycystum* C.Ag., is shown in Fig.2 populations of *Sargassum polycystum* C.Ag., was found throughout the year in the four areas selected, viz., Jodugullapalem, Visakhapatnam, Gangavaram and Pudimadaka. Young and erect fronds

developed from the perennial holdfasts in the months of March and April and some degenerating fronds of previous generation with receptacles were also observed during this period. Rapid increase in the mean length of the erect fronds was observed from May onwards in the four localities studied (Fig.2) and many of the erect fronds attained maximum size in November/December and January. The same type of growth curve was observed from the four localities but the mean length of the fronds varied slightly due to habitat variations. Plants of sheltered habitat at Jodugullapalem were taller than those of in more exposed habitat at Visakhapatnam, Gangavaram and Pudimadaka. The appearance and bushiness of the plants also varied in sheltered and exposed habitats. The standard error plotted in Fig.2 also suggests that variations within the monthly samples were minimum.

The abundance of fruiting plants observed in the four sites from December 1995 to May 1998 is shown in Fig. 3. The fertile plants were found for a short duration in a year. The fruiting period was extended for 3 to 4 months from November to February with slight variations from one site to the other in different years of this study (Fig.3). The fertile plants were observed from November onwards at Jodugullapalem in 1996-97 and from December at Gangavaram, Visakhapatnam and Pudimadaka. The percentage of fruiting plants varied during fruiting season and maximum number of fertile plants (100%) were found in the month of December/January. Number of receptacles per plant estimated is given in table 1 & fig. 4. During the three fruiting periods, the number of receptacles per plant ranged from 893 to 2931 at Jodugullapalem, 567 to 2475 at Visakhapatnam, 852 to 2367 at Gangavaram and 847 to 2027 at Pudimadaka. Minimum number of receptacles was found at the beginning and at the end of the fruiting seasons and maximum number in the months of December/January.

Figure 1: Coast line showing different study sites viz., Jodugullapalem, Vishakhapatnam, Gangavaram and Pudimadaka

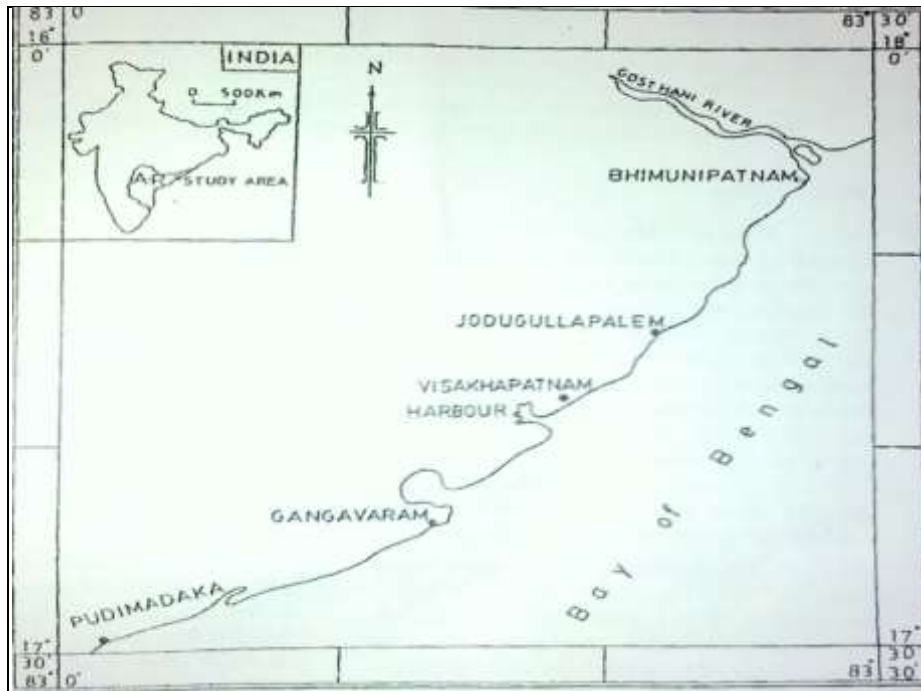


Figure 2: Seasonal changes in growth behaviour of Sargassum polycystum C.Agarth

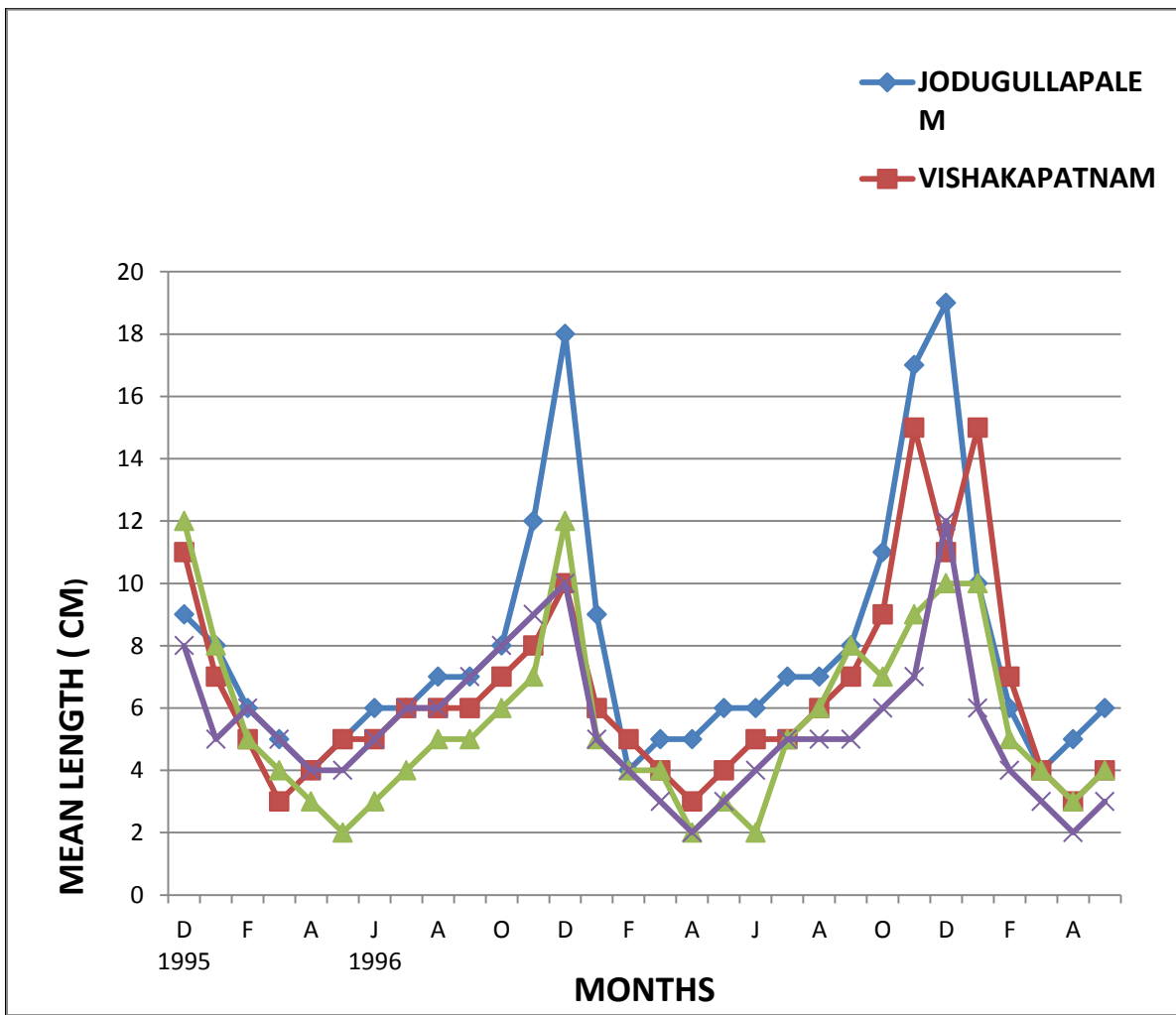


Figure 3: Seasonal changes in the percentage of fruiting plants of Sargassum polycystum C.Agardh.

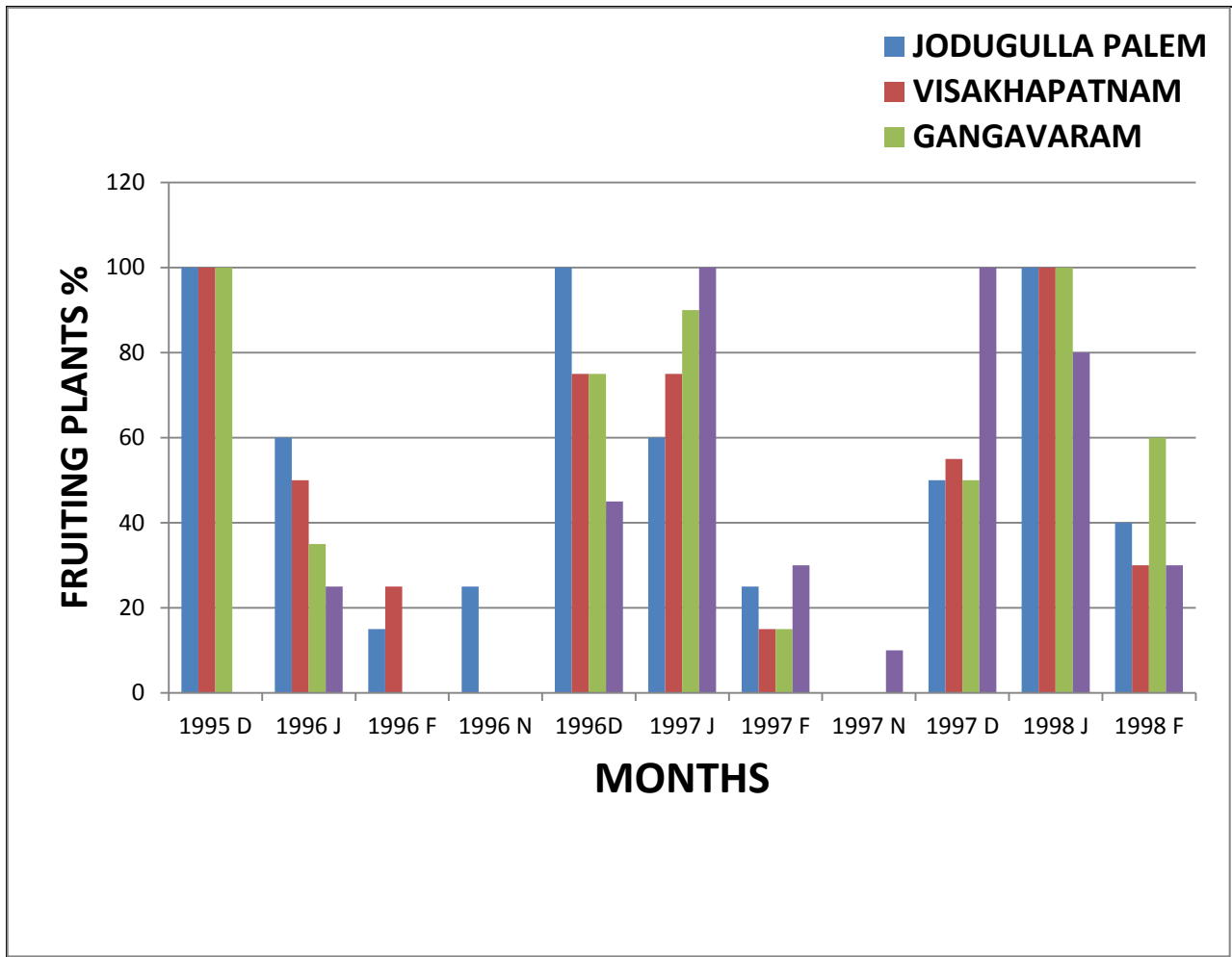


Table 1: *Sargassum polycystum* C.Agardh.

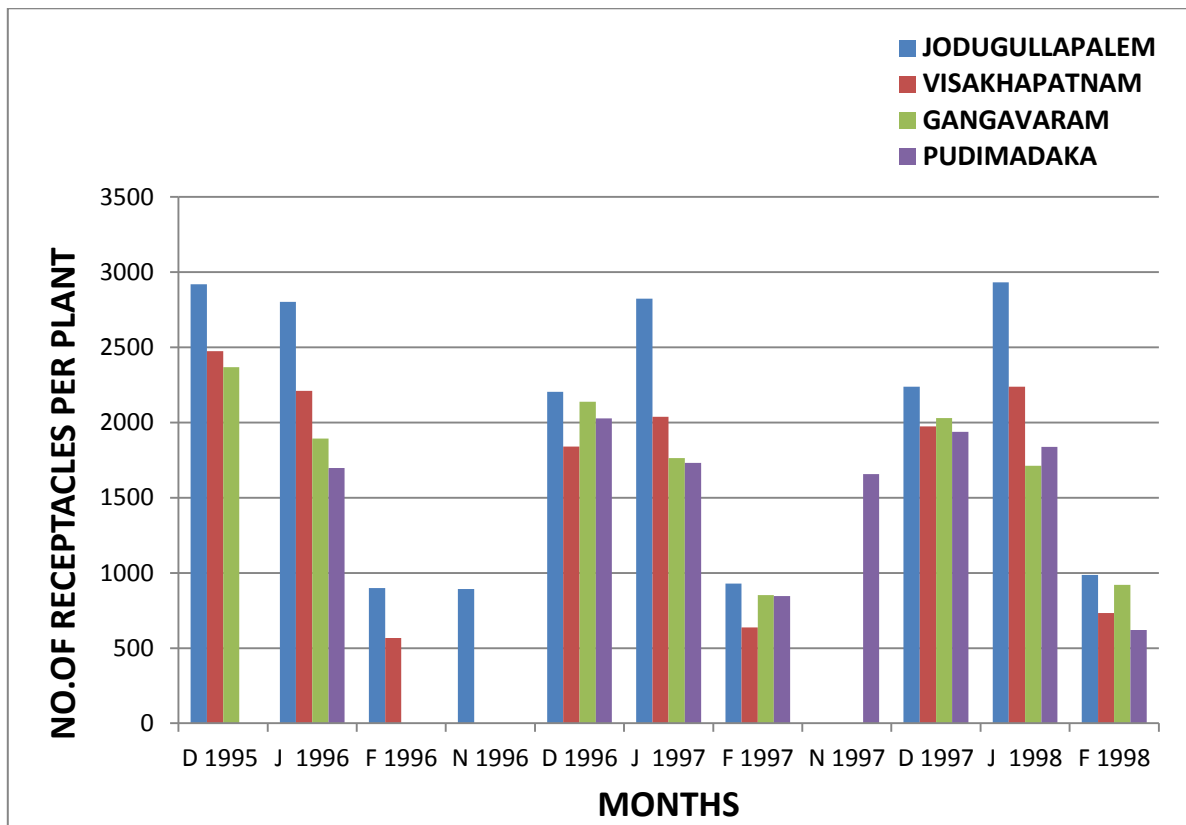
Month & Year	No. of Receptacles per plant			
	Collected at Jodugullapalem	Collected at Visakhapatnam	Collected at Gangavaram	Collected at Pudimadaka
Dec.1995	2920	2475*	2367*	-
Jan.1996	2802	2210	1893	1697
Feb. 1996	900	567**	-	-
Nov. 1996	893**	-	-	-
Dec. 1996	2203	1840	2137	2027*
Jan.1997	2823	2037	1764	1731
Feb. 1997	930	637	852**	847**
Nov. 1997	-	-	-	1657
Dec. 1997	2237	1973	2029	1937
Jan.1998	2931*	2237	1713	1837
Feb. 1998	987	734	921	621

* Highest

** Lowest



Figure 4: Seasonal changes in the no. of receptacles per plant of *Sargassum polycystum* C.Agardh



DISCUSSION

Some details on seasonal aspects of growth behaviour of some species of *Sargassum* are available in publications of Dawson(1941), Richard(1984), Srinivasan(1946) and Umamaheswara Rao and Sreeramulu(1964) and detailed ecological studies on the species of *Sargassum* occurring in different geographical areas were made in recent years (Tsuda, 1971; De Wreede, 1976; Prince and O'Neal 1979; Tanuguchi and Yamada, 1978; Umezaki, 1974; 1983; 1984 and 1986; Dawes, 1987; Fletcher and Fletcher 1975; Richard, 1984; Nunez et al., 1996). Because of the economic importance, especially as an algin yielding alga, ecological studies, particularly on the growth and fruiting cycles were undertaken on some species of *Sargassum* (Umamaheswara Rao 1969; Raju and Venugopal, 1971; Chauhan and Krishnamurthy, 1971; Chennubhotla et al., 1982). In many species of *Sargassum* investigated so far, erect shoots developed from the perennial basal parts or holdfasts, grew rapidly in different months and maximum increase in length of the erect shoots was found either in summer, late summer or winter months with a unimodal growth cycle. In *S.patens* (Tanuguchi and Yamada, 1978), *S.miyabei* (Umezaki, 1974), *S.duplicatum* (Tsuda, 1971), *S.filipendula* and *S.pteropleuron* (Dawes, 1987), plants attained their maximum height between April and June each year and in *S.muticum* (Fletcher and Fletcher, 1975) in June and July months. Umezaki (1974, 1983, and 1984) reported peak development of plants during the months of July or August. Species of *S.ringgoldianum* (Umezaki, 1986) and *S.obtusifolium* (De Wreede, 1976) attained their maximum size in the month of September. Species like *S.pteropleuron* (Prince and O'Neal, 1979) attained

maximum growth between October and December and *S.polycystum* (Tsuda, 1971) in February. In India, species of *Sargassum* such as *S.wightii* (Umamaheswara Rao, 1969) *S.plagiophyllum* (Raju and Venugopal, 1971) and *S.swartzii* (Chauhan and Krishnamurthy, 1971) reached their maximum height between October and December / January. Whereas *S.ilicifolium* and *S.myriocystum* (Chennubhotla et al, 1982) plants grew to maximum size between December and February. However, regular seasonality in growth was not reported by De Wreede (1976) in *S.oligocystum*.

In the present study at four places nearby Visakhapatnam, plants of *Sargassum polycystum* initiated its growth from March to April and attained maximum heights in the months of November, December/ January, every year with rapid increase in growth from June or July; Defoliation of erect shoots was seen in January/February. Similar growth cycle was observed in *S.vulgare* studied at Jodugullapalem and Gangavaram. These observations on *Sargassum polycystum* are in agreement with the annual growth behaviour reported for *S.ilicifolium* and *S.vulgare* of the Visakhapatnam and nearby places (Appa Rao, 1998). And all these observations on *S.vulgare*, *S.ilicifolium* and *S.polycystum* are also in agreement with the annual growth behaviour for other Indian species such as *S.wightii* (Umamaheswara Rao, 1969), *S.swartzii* (Chauhan and Krishnamurthy, 1971). In *S.ilicifolium*, studied on the South East coast of India (Chennubhotla, et al 1982), peak growth was observed up to February unlike in the present study. Similar variations in the periods of maximum development of plants were reported in the species growing in the warmer and colder parts of the Japan (Yoshida, 1960; Umezaki, 1974; 1984 and 1986;

Tanuguchi and Yamada, 1978) and other areas for *S. polycystum* and *S. pteropleuron* (Tsuda, 1971 and Prince and O'Neal, 1979). In the present study on *S. polycystum* showed only one peak period of growth i.e., during December / January every year, coinciding with the other two species of Visakhapatnam and nearby places. Viz., *S. ilicifolium* and *S. vulgare* (Appa Rao, 1998). Whereas in some red algae studied by SubbaRangaiah and Umamaheswara Rao, (1983); Sudhakar(1992); Sudhakar and SubbaRangaiah(1993); Vanilla kumari and SubbaRangaiah (1997); Vanilla kumari (1998) on the same coast, showed two peak periods of growth i.e., one in December/ January and the other in June/July every year.

The present study agrees with the statement of Richard (1984), wherein, he reported that the species of *Sargassum* shows maximum growth during colder months of the year in tropical and sub-tropical regions and during summer in temperate regions.

Fruiting plants of *Sargassum* were found for one to five months duration by many workers, during its maximum growth season. In *S. oligocystum*, *S. obtusifolium* (De Wreede, 1976); *S. patens* and *S. serratifolium* (Tanuguchi and Yamada, 1978), *S. hornerii* and *S. muticum* (Okuda, 1980), *S. ringgoldianum* (Umezaki 1986). Plants with receptacles were found in the periods from March to May. In *S. thunbergii*, *S. ringgoldianum* (Yoshida, 1960; Umezaki, 1974), fruiting plants were reported between June and October months. In other species like *S. polyphyllum* (DeWreede, 1976) *S. pteropleuron* (Prince and O'Neal, 1979); *S. foliipendula* (Dawes, 1987), *S. wightii* (UmamaheswaraRao, 1969) *S. swartzii* (Chauhan and Krishnamurthy, 1971; Murthy et.al., 1978) and *S. plagiophyllum* (Raju and Venugopal, 1971) fertile plants occurred between October and January/February. In *S. ilicifolium* studied at Visakhapatnam and nearby places, (Appa Rao, 1998) fruiting plants were observed for 6-7 months from October to April/May. Maximum number of plants with receptacles (100%) in the months of December or January, which coincides with *S. polycystum* of the present study. From March onwards, the receptacles were not healthy, though they were present till April/May. In *S. polycystum*, fertile plants were seen for 3 - 4months between November and February every year at Visakhapatnam. The fruiting cycle of Visakhapatnam and other nearby places of the present study agrees with that of the other species of *Sargassum* reported from India (Umamaheshwar Rao, 1969; Chauhan and Krishnamurthy 1971; Murthy et.al., 1978; Raju and Venugopal, 1971) and other geographical areas (De Wreede, 1976; Prince and O'Neal, 1979 and Dawes, 1987).

CONCLUSION

From the results obtained in the present study, it was observed that the maximum growth of the plants, maximum fertile plants, was found during the months of December/ January. Therefore, it is advised to harvest the plants of *Sargassum polycystum* in the field in the month of February, so that the natural populations can be maintained in the field without causing hindrance to the oospore shedding etc. And it is also advised that the harvesting of the plants can be done by cutting the plants

just above the holdfast region, keeping in view that young and erect fronds are developed from the perennial holdfast in the month of March/April, so as to maintain the natural populations for the next generation.

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