GROWTH, FRUITING CYCLE AND OOSPORE OUTPUT IN *TURBINARIA DECURRENS* BORY

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ABSTRACT

Studies on the growth, fruiting cycle and oospore output in *Turbinaria decurrens*, carried out for one year from March 1972 to February 1973 are presented in this paper. Young plants of *T. decurrens*, observed in the natural habitats in May and June, grow to maximum size in the period from December to February. Plants with receptacles occur for eleven months from August to June, with large number of fruiting plants in the peak growth season from December to February. Periodicity was not seen in the liberation of oospores and during the fruiting season peak output of spores was observed in November. From this study, it is suggested that the period December-January is suitable for harvesting the crop of *T. decurrens* in the localities around Mandapam.

INTRODUCTION

Among the three species of *Turbinaria* commonly growing in the Gulf of Mannar and Palk Bay regions near Mandapam, studies on the seasonal aspects of growth and reproduction were made on *Turbinaria conoides* (Umamaheswara Rao 1969) and *Turbinaria ornata* (Umamaheswara Rao and Kalimuthu 1972). While working on the oospore liberation in *Turbinaria decurrens* information on the growth and fruiting cycles has also been collected and the results obtained on this algin-yielding brown alga are presented here.

MATERIAL AND METHODS

T. decurrens is a sublittoral brown alga which occurs on coral boulders and sand stones in shallow areas. Samples for the present investigation were collected every month from a rocky boulder occurring in the inshore area of the Gulf of Mannar side of the coast line. Mean height of the plants and the percentage of fruiting plants in the population were estimated as described in an earlier paper on *T. ornata* (Umamaheswara Rao and Kalimuthu 1972). For computing the oospore output, the number of receptacles per plant was estimated from October 1972 by counting the receptacles of 5-10 fruiting plants. Daily

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liberation of oospores in *T. decurrens* was estimated by conducting 5 experiments per month and four mature receptacles were used in each experiment. The receptacles were placed in small petridishes kept in finger bowls and the finger bowls were filled with sterile sea water. Oospores liberated and settled in petridishes were counted for 8 to 10 days during the period of this study. While conducting the experiments finger bowls were illuminated with 14 W. day-light lamp, during the day time from 9.00 am to 5.00 pm and the sea water in the bowls was changed daily.

Results

Data collected on the mean height of the plants and the percentage frequency of small (below 5.0 cm in height) and fruiting plants are plotted in Fig. 1 to show the changes in growth and fruiting cycles of *T. decurrens* in one year. Standard deviation of the mean and the maximum and minimum height of the plants in the monthly samples are also plotted in Fig. 1A.

Growth Cycle

In *T. decurrens* the growth cycle starts from May and June when 92-98% of young plants were found on the rocky boulder where collections were made. To show the abundance of these young plants in the monthly samples, plants below 5.0 cm are plotted separately (Fig. 1B). In July also 68% of the plants in the population are less than 5.0 cm in length. In these three months from May 1972 to July 1972, because of the homogenous nature of the population, the standard deviation of the mean values was less (Fig. 1A) when compared to the other months of the year. After July 1972 the mean height was more and many of the plants attained their maximum size in the period December 1972 to February 1973. The turbinate leaves and receptacles occurring in the basal parts of the plants showed signs of degeneration from January or February. These are gradually shed leaving the main axis with a cluster of leaves at the upper parts. Plants are also covered by epiphytic algae and other organisms and many of these old and spent fronds gradually disappear in the months of March and April.

In October 1972 small plants below 5.0 cm were not seen in the population and again from November onwards juveniles or plantlets of next generation occurred in the samples collected. The percentage of these young plants varied between 4.0 to 9.3% during the period from November to January and increased further during the degenerating or final phase in the growth cycle of *T. decurrens* (14 to 30% from February to April). Owing to the development of young plants from November and occurrence of two generations in various proportions (Fig. 1A, B), the standard deviation of the mean values and the maximum and minimum range in the samples were more for the period from December to April. From these findings for one year it can be said that 92-98% of small plants of *T. decurrens* observed in May and June, grow to maximum

size in the natural habitats after 6 to 7 months with a single peak in the growth cycle between December and January|February. The growth cycle of *T. decurrens* is similar to that of *T. conoides* and *T. ornata* growing in the Gulf of Mannar and Palk Bay respectively. Monthly changes in growth and fruiting are more related to *T. ornata* (Umamaheswara Rao and Kalimuthu 1972).

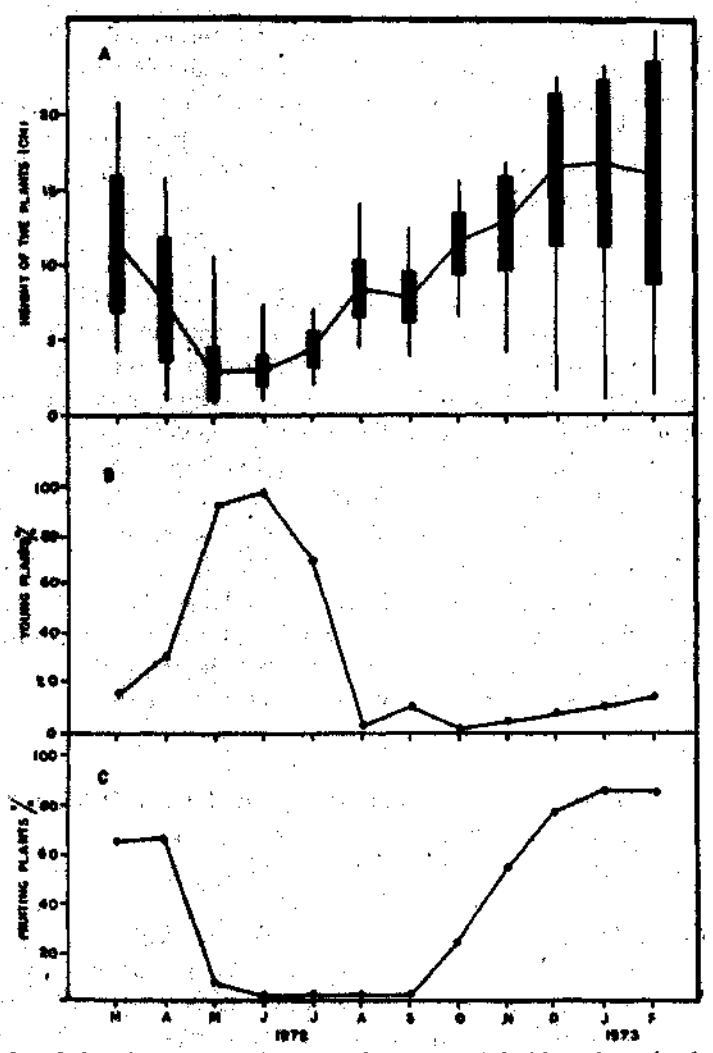

FIG. 1. Height of the plants and percentage of young and fruiting plants in the population of *T. decurrens*.

From the changes in the mean height of the plants during the growth cycle and from the time taken for maximum development a rough estimate of the growth rate per day has been made and the value obtained is given below.

Period of increase in length	*Increase in mean length (cm)*	*Growth rate/day (mm)*
26-6-72 to 27-12-72 (183 days)	13.6	7.4

Vegetative propagation

From the basal parts of *T. decurrens* many branched stolons or haptera arise and spread horizontally on the substratum in all directions. Several new plants grow from these stolons and this mode of vegetative reproduction by means of stolons has been observed in other species of *Turbinaria*. These plantlets are commonly found on stolons when the plants of the previous generation are in a degenerating condition.

Fruiting cycle

Figure 1C shows the changes in the abundance of fruiting plants in the population of *T. decurrens* during the period from March 1972 to February 1973. Plants examined in July 1972 were vegetative and only one fruiting plant with young receptacles was seen in the samples collected in August and September. With increase in the growth, the number of fruiting plants increased and 78 to 87% of the plants were in fruiting condition during the maximum growth period from December to February. In March and April also fruiting plants of this generation were seen in large numbers (Fig. 1C) and their number declined considerably by May due to shedding of all old fronds. From the above analysis of the population it is evident that the fruiting cycle of *T. decurrens* starts from August or September and extends up to June next year. Within this protracted fruiting period of nearly eleven months, the maximum number of plants with receptacles occur for seven months, between October and April.

Oospore output

Experiments on oospore output were started from October 1972, when a good number of well-developed fruiting plants were seen in the samples (Fig. 1C). Data on oospore output were collected for five months only. The mean values of 25 experiments conducted from October 1972 to February 1973 are plotted in Fig. 2 to show the pattern of liberation of oospores continuously for a period of seven days. In *T. decurrens* also periodic liberation of spores was not found and the oospores in different stages of development were first seen on receptacles as observed in *Sargassum wightii* (Umamaheswara Rao and Kaliaperumal, unpublished) and other brown algae. Maximum output was seen on fourth day (Fig. 2) and thereafter the number of spores liberated per receptacle decreased rapidly. After seven days the receptacles used for the experiments showed signs of degeneration and the spores liberated were also in degenerating condition.

Data collected in different months of the fruiting season from October 1972 to February 1973 are given in Table 1. As healthy spores were observed for seven days, total oospore output per plant has also been estimated and shown in the last column of Table 1.

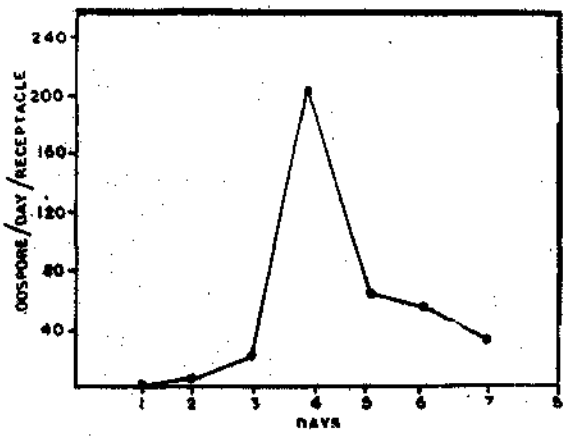

FIG. 2. The mean values of oospore output in *T. decurrens.*

During the fruiting season of *T. decurrens,* spore output per receptacle per day was high in November and December (Table 1) and lowest in January 1973. The number of receptacles per plant varied during the five months of this study and these changes may be due to shedding of leaves with receptacles and size of the plants selected for estimation. Settlement of plants, animal eggs and other epiphytic organisms and degenerating conditions of the plants may further influence spore production form the plants. In February 1973 the reproductive bodies were liberated after 8 days without showing any divisions. These may be unfertilized or immature eggs. From these observations made for five months of

TABLE 1. *Oospore output in* T. decurrens *during the period from October* 1972 *to February* 1973.

Month	Number of receptacles/ plant	Mean oospore output/ receptacle/day	Oospores/ day/plant	Oospores/ plant
October 1972	15	12	180	1260
November 1972	53	76	4028	28196
December 1972	25	46	1150	8050
January 1973	35	13	455	3185
February 1973	64	21	1344	9408

the fruiting season, it may be mentioned that plants of *T. decurrens* shed maximum number of oospores during the early phase of the fruiting cycle (i.e. up to November) and in the other months shedding activity decreases depending upon the condition of the plant. Detailed studies are, however, necessary to get a complete picture of the oospore shedding season,.

Harvesting season

From the above account on the growth and reproduction of *T. decurrens*, it is clear that the first two months of the peak growth season, December-January, appear to be suitable for harvesting *T. decurrens* in the vicinity of Mandapam. Although information on the seasonal changes in alginic acid of *T. decurrens* is not available, fluctuations are not marked in *Turbinaria* species analysed so far and good yield was obtained during the peak growth season (Umamaheswara Rao 1969, Umamaheswara Rao and Kalimuthu 1972). The oospores liberated from the fruiting plants present from October onwards and also the plantlets arising from the stolons would help in the regeneration and maintanence of the population of *T. decurrens* in the natural habitats and collection in December and January may not affect the density of this alga year after year. Since the basal attaching haptera contribute much to the development of young plants, the basal portions of the plants should not be destroyed while harvesting the crop in December and January. If detailed field experiments are conducted it may be possible to cultivate *T. decurrens* by vegetative means using stolons with plantlets.

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