Changes in Mannitol and Alginic Acid Contents of Turbinaria ornata (TURNER) J. AGARDH in Relation to Growth and Fruiting

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Umamaheswara Rao and Kalimuthu: Changes in Mannitol and Alginic Acid Contents of Turbinaria ornata Botanica Marina Vol. XV, p. 57--59, 1972 Central Marine Fisheries Research Institute, Regional Centre, Mandapam Camp,, India M. UMAMAHESWARA RAO and S. KALIMUTHU (Received 28. 7. 71) Biological and chemical studies have been conducted on some important species of Sargassum and Turbinaria to determine the optirnum periods for harvesting the algin-yielding seaweeds o£ the Mandapam area (UMAMAHESWARA RAO, 1969). The present paper reports the results obtained on growth, fruiting in relation to quantitative changes in mannitol and alginic acid contents of Turbinaria ornata (TÜRNER) J. AGARDH for a period of four years, from January 1967 to December 1970. Materials and Method Turbinaria ornata in the Palk Bay, near Mandapam, commonly grows on coral debris and coral stones at l -- 2 m depth. About 50--100 plants were collected from this area at monthly intervals. Total length of all the plants was measured in the laboratory and mean heights of the plants together with their Standard deviations were calculated. Chemical analysis of the dried plants was carried out äs reported earlier (UMAMAHESWARA RAO, 1969). Because of the rough weather prevailing during the north-east monsoon season> each year, samples could not be collected in certain months from November to January and February. While measuring the plants, observations were made on the fruiting condition during the first two years to determine the reproductive period of Turbinaria ornata* For the years 1969 and 1970 the percentages of the plants which were in fruiting stages in each month, were determined. Results Monthly changes in growth, reproduction and chemical constituents of Turbinaria ornata are shown in Figure l and each of these can be summarized äs follows: Growth cycle\ Small plants of Turbinaria ornata were seen in February and their rate of growth was slow till the end of May or June each year (Fig. 1). From July the growth o£ the plants in the population becomes rapid and fully grown plants were collected from October to December. Owing to turbulent conditions in the inshore environment during the peak growth period fully grown and older plants are detached from the substratum and they disappear by the end of December or January. After the monsoon season again small Botanica Marina / Vol. XV / 1972 / Fase, l plants of next generation, ranging l -- 3 c m in length, were found on coral rocks from February onwards. The ränge in height of the plants together with the Standard deviation of the mean values have been plotted in Figure 1. From this figure it is clear that there is a size Variation in different months during the period of this investigation. The Standard deviation of the mean

values is greater during the maximum growth period of this alga than in the early stages of growth. These variations may be attributed to factors like the irregular growth of the plants> removal of well-developed plants during the monsoon season and overlapping of populations of the two generations in the maximum growth and degenerating periods. Growth curves presented in Figure l also indicate the year to year variations in the height of the plants. In 1969 old plants of the previous generation were found in the samples collected till April, unlike in the other years of this study, Young plants were observed from May onwards and the samples were collected till the end of December 1969 when calm conditions prevailed during this year, Reproductive cycle: While examining the samples collected in the first two years of this study, it has been found that the reproductive receptacles occur on this alga for most part of the year. Receptacles were not seen only in the early stages of the growth cycle (Fig. 1) but they were usually found on the plants after attaining a height of 4 or 5 cm, Plants of this alga are monoecious, The fruiting periods observed during the four years of this study are given below: Year Fruiting period March--October March--November February--December April--October The number of plants bearing receptacles varied from month to month in the population. Data on the percentages of fruiting plants estimated from the samples collected in the years 1969 and 1970 are shown in Figure 1. In 1969, äs plants of the previous generation occurred in the samples, 70--80% of the plants were seen in fruiting condition during February and March and minimum percentage in May and June. The number of fruiting plants increased from July onwards and 92.3 -- 100% of the plants occurred in fruiting condition Umamaheswara Rao and Kalimuthu: Changes in Mannitol and Alginic Acid Contents of Turbinaria ornata GROWTH CYCLE 16-1 ^100 FRUITING CYCLE 6040- < ,- CL MANNITOL 3 < UJ tr o 40 o ALGINIC ACID J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D 1967 l 96 l 1969 l 1970 Fig, l Variations in growth, f r u i t i n g , mannitol and alginic acid contents of Turbinaria ornata during the years 1967 to 1970. The narrow vertical lines in the growth curves show the r nge in height of the plants in monthly samples and the broad Lines indicate the Standard deviations of the mean values. during the maximum growth period (October to December). In 1970, plants with receptacles were seen in April and by the end o£ October 76.6% of the plants examined were with receptacles (Fig. 1). Quantitative changes in manitol and alginic acid: Monthly changes of mannitol observed in Turbinaria ornata were somewhat irregular (Fig. 1). However, from the seasonal trends observed in the four years it may be pointed out that high mannitol content in this alga occurs during the early stages of the growth, roughly from February to May. The amount of mannitol decreases with the development of reproductive organs and with the increase in the number of plants bearing receptacles in the population. This inverse relationship between mannitol content and reproductive cycle can

be clearly observed from the data presented in Figure l for the years 1969 and 1970. Although an increase in the mannitol content has been observed again in October and December (Fig. 1), these values are lower than those obtained during the vegetative phase of the growth cycle. Botanica Marina / Vol. XV / 1972 / Fase, l Rao and Kalimuthu; Changes in Mannitol and Alginic Acid Contents of Turbinaria ornata Marked changes did not occur in the alginic acid content during the growth and development phase of Turbinaria ornata. High yield of alginic acid was obtained both from the young and fully grown plants with minor variations in the samples from month to month. Discussion The results obtained in this study indicate that Turbinaria ornata grows to maximum else between October and December and the annual growth cycle of this alga is similar to that observed in Sargassum wightii and Tttrbinaria conoides growing in the Gulf of Mannar along the coastline near Mandapam (UMAMAHESWARA RAO, 1969). The fruiting behaviour of this alga is however, different from the other two species of brown algae investigated earlier. In Sargassum wightii and Turbinaria conoides reproductive receptacles were seen for three to four months, from October to January. Turbinaria ornata on the other band, seems to have a prolonged fruiting period of 8 -- 10 months and the number of fruiting plants varies from month to month, which closely agrees with the growth cycle of this alga (Fig. 1). Similar changes in the abundance of fruiting plants were not seen in the other algae of Mandapam (UMAMAHESWARA RAO, unpublished) and the Visakhaptnam coasts (UMAMAHESWARA RAO and SREERAMULU, 1970), where reproduction was observed throughout the year. Regulär changes of the type found in the mannitol and alginic acid of Sargassum wightii and Turbinaria conoides (UMAMAHESWARA RAO, 1969), were not observed in Turbinaria ornata. The fall in the mannitol content, associated with the development o£ reproductive structures (Fig. 1), suggests that the reproductive cycle has an influence on the chemical composition of seaweeds and these changes are in agreement with the observations made on other brown algae QONES, 1957; UMAMAHESWARA RAO, 1969). From the biological and chemical data collected in this study it maybe concluded that the period from October to December is suitable for commercial exploitation of Turbinaria ornata near Mandapam. Since a good number of plants were found reproducing from May onwards, the oospores liberated during the other months of the harvesting season would help in maintaining the population of this alga. References JONES, R. F.» 1957, Variation of nitrogen and carbohydrate constituents during the development of Himanthalia ttongata (L,) S* F. GRAY, Bioh BulL, 112\ 81--91. -- UMAMAHESWARA RAO, M,, 1969, Seasonal variations in growth, alginic acid and mannitol Contents of Sargassum wightii and Turbinaria conoides from the Gulf of Mannar, India. Proc. 6th Int. Seaweed Symp., pp, 579--584. -- UMAMAHESWARA

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