INFLUENCE OF LOW AND HIGH TEMPERATURE ON DIURNAL PERIODICITY OF TETRASPORE SHEDDING IN SOME RED ALGAE

ABSTRACT

Influence of low and high temperature on diurnal periodicity in tetrespore output from *Gelidium pusillum*, *Petrocladia heteroplatos* and *Gelidiopsis variabilis* was investigated. In general, peak shedding of spores was delayed than the normal periodicity in *G. pusillum* and *G. variabilis* at low (0 and 20°C) as well as high (40°C) temperature. Temperature plays a major role in altering the peak liberation of tetraspores in a day in these three red algae.

INFORMATION on the spore producing capacity of commercially important seaweeds is necessary to cultivate them by reproductive propagation method. Studies were made by several workers on spore shedding of different marine algae. Only very fragmentary information is available regarding the influence of environmental factors on spore liberation and its diurnal rhythm (Katada, 1955; Umamaheswara Rao and Subbarangaiah, 1981; Umamaheswara Rao and Kaliaperumal, 1983; Subbarangaiah, 1985; Kaliaperumal and Umamaheswara Rao, 1987). The effect of temperature on the liberation of tetraspores in the agar yielding seaweeds *Gelidium pusillum* (Stackhouse) Lat Jolis, *Pterocladia heteroplatos* (Boergesen) Umamaheswara Rao and Kaliaperumal and *Gelidiopsis variabilis* (Graville) Schmitz had

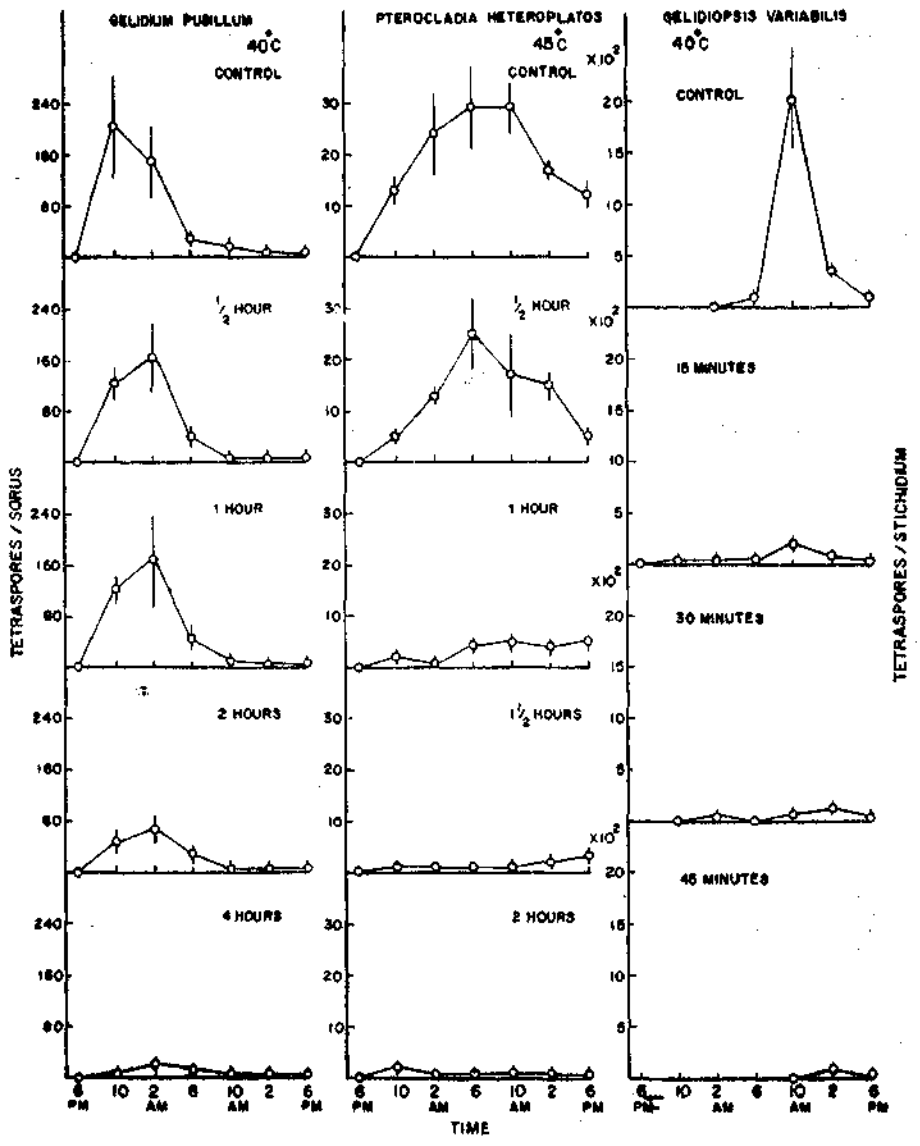

Fig. 1. Changes in diurnal periodicity of tetraspore output from fronds of *G. pusillum* and *P. heteroplatos* treated for short periods at 0°C and *G. variabilis* at 0 and 20°C (Vertical lines show standard error to the mean values).

been studied (Umamaheswara Rao and Kaliaperumal, 1983; Kaliaperumal and Umamaheswara Rao, 1987). The influence of low and high temperatures on diurnal periodicity of tetraspore output from these three red algae growing at Visakhapatnam Coast are presented in this note.

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Materials and methods

Plants of *G. pusillum*, *P. heteroplatos* and *G. variabilis* were collected in March-May and September-October 1978 from the intertidal region of Visakhapatnam Coast during spring tides in the afternoon. As described by Umamaheswara Rao and Kaliaperumal (1983) fertilte terasporic thalli were selected and used for spore liberation experiments. The experiments were conducted in the laboratory by keeping the petri dishes with materials in a temperature controlled dark incubator and deep freezer. Since there was no sporulation from tetrasporic fronds of *G. pusillum* and *P. heteroplatos* and stichidia of *G. variabilis* treated for 24 hr at low and high temperature, experiments were conducted by treating the plants at these temperature for short periods. The untreated sets kept for 24 hr at room temperature in a dark chamber were treated as controls. *G. pusillum* was treated for 1, 2, 3 and 4 hr at 0°C and ½, 1, 2 and 4 hr at 40°C. *P. heteroplatos* was treated for 4, 8, 12 and 16 hr at 0°C and for ½, 1, 1½ and 2 hr at 45°C. *G. variabilis* was treated for ½, 1, 1½ and 2 hr at 0°C ; 4, 8, 12 and 16 hr at 20°C and 15, 30 and 45 minutes at 40°C.

After the temperature treatment all experimental sets were maintained at room temperature in the dark chamber for remaining period of the day. The experiments were commenced from 1800 hr and the spores liberated into the petri dishes at 4 hr intervals were counted following the method of Umamcheswara Rao and Kaliaperumal (1983). Mean values of 10 experiments conducted for each temperaure treatment using *G. pusillum* and *P. heteroplatos* and 5 experiments with *G. variabilis* are plotted in Figs. 1 and 2 and the data are presented as tetraspores/sorus and tetraspores/stichidium.

Results

Data collected on shedding of tetraspores from tetrasporic fronds of *G. pusillum* and *P. heteroplatos* treated for short periods at 0°C and 20°C are given in Fig. 1. Data obtained in control experiments are alo plotted for comparison. In the experiments conducted at 0°C with *G. pusillum* during September-October, peak output was observed between 6 PM and 10 PM in control and thalli treated for 1 hr. The peak shedding was delayed by 4 hr *i.e.* from 10 PM to 2 AM in fronds treated for 2 hr and 3 hr. The spore output markedly decreased at different periods of the day in fronds treated for 4 hr with maximum output-between 2 AM and 6 AM. In *P. heteroplato* more number of spores were found between 2 AM and 6 AM in control and thalli treated for 4 hr at 0°C. Four hour delay in the maximum shedding was observed in fronds treated for 8 hr. The spore output was very less in 12 hr and 16 hr treatments and maximum liberation was found from 2 PM to 6 PM.

In experiments conducted during September, October with *G. variabilis* at 0°C, the diurnal periodicity for ½ hr and 1 hr treatment were similar to those of controls with peak libertion between 6 AM and 10 AM. At 1½ hr and 2 hr treatments, the peak output of spores was delayed by 4 hr from 10 AM to 2 PM. In experiments conducted at 20°C during the month of April, there were no changes in the diurnal periodicity between control and sitchidia treated for 4 hr, with peak shedding of spores from 6 AM to 10 AM. But in sitchidia treated for 8 hr, peak spore output was delayed for 4 hr from 10 AM to 2 PM. At 12 hr and 16 hr treatmen., 8 hr delay in the peak liberation was seen with maximum sporulation between 2 PM and 6 PM.

Figure 2 shows the results obtained on diurnal periodicity in tetraspore liberation from *G. pusillum* and *G. variabilis* treated at 40°C and *P. heteroplatos* treated at 45°C for short

periods. The data collected from the control experiments are also plotted. In the experiments conducted with *G. pusillum*, during March-May, at 40°C peak spore output was observed between 6 PM and 10 PM in control and between 10 PM and 2 AM with 4 hr delay in ½ hr to 4 hr treatments. In *P. heteroplatos* maximum sporulation was found from 2 AM to 10 AM in control experiments. Peak output was seen between 2 AM and 6 AM in fronds treated for 2 hr at 45°C. The spore output values were very low and irregular in fronds

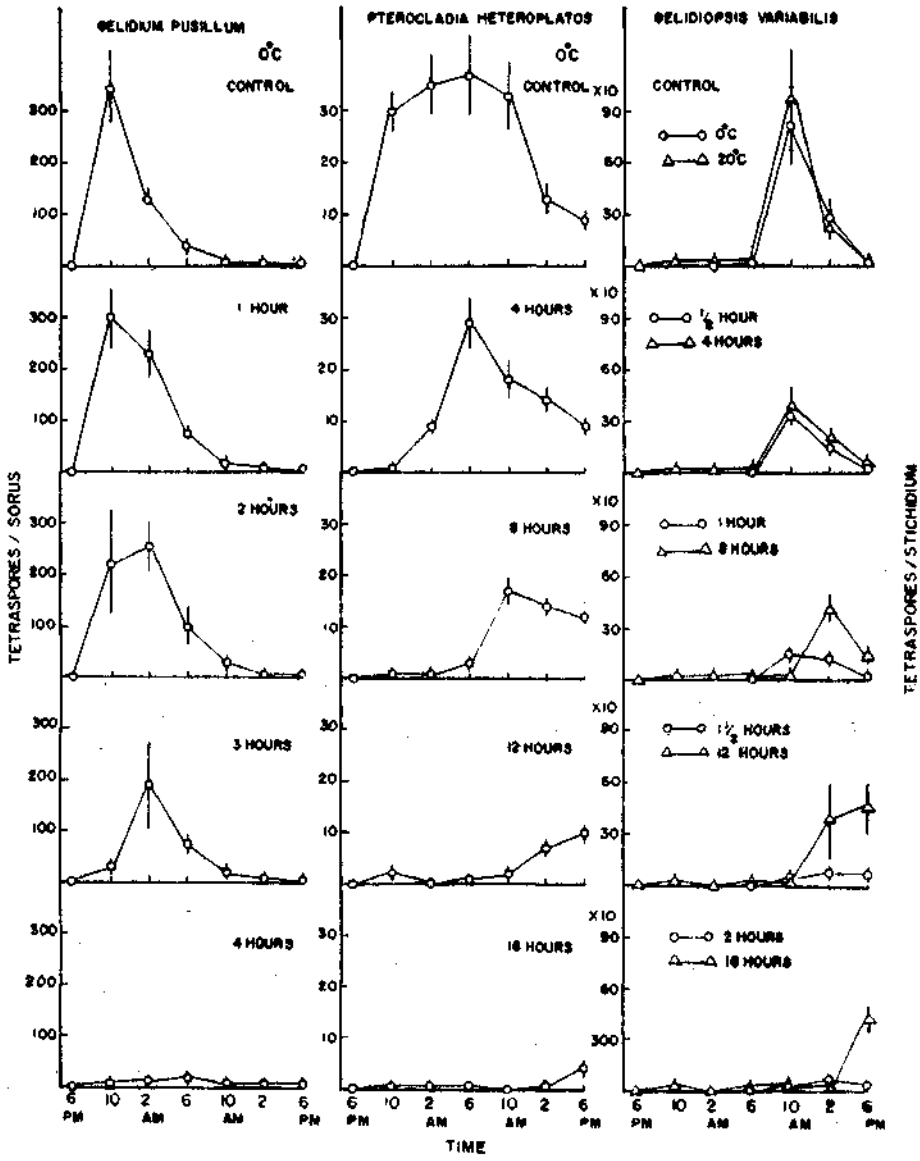

Fig. 2. Changes in diurnal periodicity of tetraspore liberation from fronds of *G. pusillum* and *G. variabilis* treated for short periods at 40°C and *P. heteroplatos* at 45°C (Vertical lines show standard error to the mean values).

treated for 1, 1½ and 2 hr. Experiments conducted with *G. variabilis* at 40°C during September-October, peak spore output was observed between 6 AM and 10 AM in control and in 15 minutes treatment. The spores liberated at 15 minutes treatment were only 10% of the control experiments. The number of spores liberated was also less in 30 and 40 minutes treatments with 4 hr delay in peak liberation from 10 AM to 2 PM.

Discussion

Regular diurnal periodicity in tetraspore output with peak liberation during night time in *G. pusillum* and during day time in *G. variabilis* was observed. The pattern of the diurnal curves changed seasonally in these two red algae with 4 hr delay in peak shedding of spores during winter months from December to February/March. But in *P. heteriplatos*, there was no regular trend in the diurnal periodicity of tetraspore release and there was no seasonal variation in the pattern of diurnal curves (Umamaheswara Rao and Kaliaperumal, 1987).

The low and high temperature altered the peak shedding of spores in *G. pusillum*, *P. heteroplatos* and *G. variabilis* (Figs. 1 and 2) while in *Iridophycus cornucopiae* water temperature had no effect on the diurnal periodicity of spore liberation (Fukuhara, 1957). Peak liberation of tetraspores was delayed in *G. pusillum* and *G. variabilis* when sea water temperature was below 30°C. In fronds of *Gracilaria corticata* and *Hypnea valentiae* treated for short periods at 10°C, peak shedding of tetraspores was delayed for 4 to 8 hr (Subbarangaiah, 1985). Similarly in the present study also peak shedding of tetraspores was delayed in *G. pusillum* and *G. variabilis* treated for short periods at low temperatures of 0°C and 20°C.

In fronds of *G. corticata* and *H. valentiae* treated for short periods at 40°C, peak output of tetraspores was observed 4 hr earlier than the normal periodicity (Subbarangaiah, 1985). But in the present investigation, peak shedding of tetraspores was delayed in *G. pusillum* and *G. variabilis* treated for short periods at high temperature of 40°C. More detailed studies are needed to understand this variation observed in the daily periodicity of spore liberation at high temperatures in these algae. In *Gelidium amansii* the time of peak shedding of spores varied depending on the seasonal changes in sea water temperature (Katada *et al.*, 1953; Katada, 1955). The present study agrees with the findings on *G. amansii* and it also confirms the relationship between diurnal rhythm in spore release and sea water temperature.

Department of Botany,
Andhra University, Waltair.

N. KALIAPERUMAL*

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* Present address: Regional Centre of Central Marine Fisheries Research Institute, Marine Fisheries, 623 520, Tamil Nadu, India.