Effect of Thermal Stress on Spore Shedding in Some Red Algae of Visakhapatnam Coast

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Effect of thermal stress on the liberation of tetraspores from *Gelidium pusillum* (Stackhouse) Le Jolis, *Pterocladia heteroplatos* (Boergesen) Umamaheswara Rao and Kaliaperumal and *Gelidiopsis variabilis* (Greville) Schmitz was studied, in response to temperatures lower (0°-10°C) and higher (40°–45°C) than the tolerance limits of plants. Spore liberation was seen in these algae exposed to low and high temperatures for short durations but the output decreased with increase in the duration of treatment. The temperature tolerance capacity varied in the algae tested.

In *Gracilaria*, *Hypnea*, *Gelidium*, *Pterocladia* and other red algae of the Visakhapatnam coast, spore discharge was seen at certain temperatures and temperature tolerance ranges for spore shedding varied in these algae[1,2]. In the present investigation experiments were conducted on some species of red algae to understand the effect of thermal stress on spore shedding at temperatures higher and lower than the tolerance limits of these algae.

Tetrasporophytes of *G. pusillum* (Stackhouse) Le Jolis, *P. heteroplatos* (Boergesen) Umamaheswara Rao and Kaliaperumal and *G. variabilis* (Greville) Schmitz collected from the infralittoral fringe zone at Visakhapatnam during different months in 1978, were used in the present study. Fertile clumps of *G. pusillum* and *P. heteroplatos* and stichidia of *G. variabilis* were placed in petridishes filled with sterile seawater. Temperature treatment was given to plants kept in petridishes for 1 to 24 h and at high temperature exposures of <1 h were also used. Plants of *G. pusillum* were exposed to 0°, 10° and 40°C, *P. heteroplatos* to 0° and 45°C and *G. variabilis* to 0°, 15°, 20° and 40°C. Dark incubator was used for exposing petri dishes with fruiting material at 40° and 45°C and deep freezer and low temperature chamber were used for experiments at low temperatures.

After treatment, experimental sets were maintained at room temperature in a dark chamber for the remaining period of the day. Untreated sets kept for 24 h at room temperature were treated as controls. At the end of each experiment the liberated spores and seawater in petri plates were mixed with a brush and the spores present in the seawater were counted[2] using a plankton counting chamber. From the mean values of 2 counts and the number of sori present on the fertile clumps of *G. pusillum* and *P. heteroplatos* and stichidia of *G. variabilis*, the quantity of spores (tetraspores per sorus or stichidium per day) liberated were estimated. While estimating the tetraspore output, percentage frequency of the dividing spores was calculated separately to know the rate of germination of spores within 24 h. Ten replicates were maintained for experiments with *G. pusillum* and *P. heteroplatos* and only 5 with *G. variabilis*.

In *G. pusillum* the spore shedding (Fig. 1) was more than the control in fronds treated for 1 h at 0°C and less than the control in fronds exposed for 2 h; shedding was inhibited completely in fronds treated for 6 h. At 10° and 40°C the spore output decreased with increasing duration of exposure but at these temperatures some shedding was seen even after 16 h treatment.

In *P. heteroplatos* rapid decline in spore output was observed (Fig. 1) in plants exposed for 4 to 12 h at 0°C and shedding was minimum for 12 h (Fig. 1). At 45°C spore output decreased within 2 h of exposure and the output was minimum between 2 and 6 h treatment at this high temperature.

In *G. variabilis* also spore output was less than the control in treatments given at 0°, 15° and 40°C (Fig. 1). Spore liberation found for 1 h at 40°C, for 2 h at 0°C and 12 h at 15°C indicates the sensitive nature of this alga to low and high temperatures. *G. variabilis* exposed for 8 h at 20°C liberated more number of spores than the control and plants exposed for 4 h. After 8 h treatment, spore production decreased gradually and shedding was seen up to 20 h treatment.

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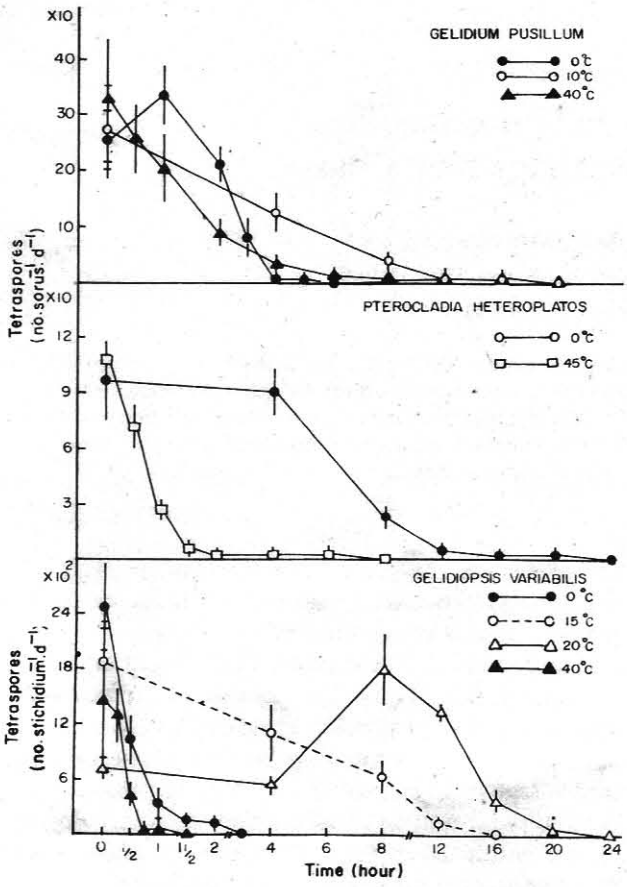

Fig. 1 — Variations in tetraspore output from fronds of red algae in response to temperature treatments (Vertical lines show standard error to the mean values)

Spore germination with in 24 h of experiment is given in Table 1. Majority of spores liberated germinated usually from 2nd or 3rd d onwards under laboratory conditions. Therefore the rate of germination (in 24 h) was low in the present study. In *G. pusillum* exposed to 10°C 1-2% of spores divided and < 1% spores of *G. pusillum* and *P. heteroplatos* germinated at 0° and 40°C treatments. Spores of *G. variabilis* did not germinate in all temperatures tested (Fig. 1).

Cultures and fertile thalli were exposed by some workers to a wide range of temperatures to know the relationship between temperature and sporulation and the optimal conditions required for spore shedding[2-6]. These experiments were conducted under constant temperature condition and studies relating to the effects of change of water temperature or thermal shock on spore liberation were very few[7]. The present study indicates that *G. pusillum*, *P. heteroplatos* and *G. variabilis* growing at Visakhapatnam coast can tolerate exposure to very low (0° to 10°C) and high (40° to 45°C) temperatures and liberate spores contrary to earlier findings[7] in *Gloiopeltis* spp. Germination was also observed especially at the low temperature tested (Table 1). However, the thermal shock given could not enhance spore liberation from these algae. The spore output declined rapidly with increasing duration of treatment except in *G. pusillum* treated for 1 h at 0°C and *G. variabilis* exposed for 8 h at 20°C (Fig. 1). As already suggested[2] the sensitive nature of *G. variabilis* to low temperature treatments (0°-10°C) and absence of germination at different temperatures tested in this study, show that it is a stenothermal species. Liberation of spores in *G. pusillum* and *P. heteroplatos* in 5-20 h treatments at 0° and 10°C and germination of a small percentage of tetraspores observed in this study also indicate that these Gelidioid members are eurhythermal in nature. These differences under thermal stress can be related to the geographical distribution of these red algae[8].

Table 1 — Germination Rates of Tetraspores in Different Temperature Treatments

Temp. (°C)	Alga	Duration of thermal stress(h)	% germination of tetraspores
0	*G. pusillum*	1-3	0.6-0.9
10	-do-	4-8	1.7-2.2
40	-do-	1/2-8	0.1-0.7
0	*P. heteroplatos*	4	0.2
45	-do-	1/2-6	–
0	*G. variabilis*	1/2-2	–
15	-do-	4-12	–
20	-do-	4-20	–
40	-do-	1/4-1	–

– No germination

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