Studies on *Gelidiella acerosa* (FORSSKÅL) FELDMANN et HAMEL. IV : Spore Studies

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The environment influences marine algae at all stages in their life, but its influence on the shedding, fixation and germination of spores is of a paramount importance.

Studies regarding the shedding, floating and fixing of spores in *Gelidium* were mainly from Japanese workers (SUTO,[1,2] KATADA, MATSUI *et al.*[3], KATADA,[4]). SUTO[1] described seven ecological groups of spores based on their swimming ability, the zone in which the parent plants grew and the zone to which they fixed themselves. He further stated that shedding, swimming and fixing habits were the characteristics of each group. Informations on these aspects of the spores of *Gelidiella* is still lacking. As a part of the study on the life-history of *Gelidiella acerosa*, an ecological survey of spore shedding and fixation and a study of factors effecting the spore-shedding was undertaken.

Method

a Shedding of spores : The method given by SUTO[1] was adopted for settling spores from pool water. The typical method of germination of the spores of *Gelidiella* was used to identify its spores during counting. Similarly, the method given by KATADA[4] was used in finding the periodicity of the spore shedding from plants in the laboratory. The material used in each experiment was only one fully grown plant with three erect axes bearing many tetrasporangial ramuli. The plants were collected at the end of the exposure periods on the day. The spore count was made at an hourly interval during 12 hours.

b Counting of spores : Using the mechanical stage, the glass plate containing spores was moved in line and the mean value of the count was used for estimating the rate of liberation of spores. This method was called by KATADA[4] as count by rows or "obi" method.

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The Bulletin of Japanese Society of Phycology, Vol.XIX. No.1, 9—14,Apr. 1971

c Fixing spores : A single fertile ramulus was kept on a slide in a few drops of seawater and it was observed under microscope for liberation of spores. When the spores were liberated on to the slide, the ramulus was removed and the slide was used to find the time of fixing of spores. By the flow of seawater, the non-adherent spores were washed off the slide.

Observations and results

Shedding : It was observed that the alga under investigation has two spore shedding seasons in an year, first shedding during April-May and the second during October-November (RAO, in Press). The shedding period extends over 25 to 30 days during each season.

Time of liberation of spores : Two types of experiments were conducted in October-November to find the time of liberation of spores in a day. They were (a) number of spores shed in the pool water during exposure and (b) number of spores shed from plants in the laboratory.

(**a**) Number of spores shed in the pool water during exposure : Practically no germinating spores were observed on the slides kept in the experimental tubes with one or two exceptions. Even in these exceptional cases, the number of germinating spores were one or two per slide. As the count has been so insignificant, it can be taken that the pool water has no spores during exposure.

(**b**) Number of spores shed from the plants in the laboratory : The results of the hourly counts made during the period of shedding of spores are recorded in Fig. 1.

The following conclusions can be drawn from the above experiments : a) The liberation of spores in the laboratory was more in the experimental material collected in the afternoon than in that collected in the early morning. b) The shedding of spores was found to be completed within a period of 12 hours in both cases. c) The shedding of spores was more at the beginning of each shedding in both cases.

Effect of drying of the plants in shade on shedding : The following experiments were conducted during October-November in order to find the effect of drying of the fertile tetrasporic plants on the shedding of spores. The healthy plants with plenty of mature tetrasporangia were collected from the tide-pool and brought to the laboratory on the shore in a bucket of water. Care was taken to see that the plants were not exposed to direct sunlight after collection. All the plants were in the same stage of development and one plant was used for each treatment. Before giving the varying treatment of drying, each plant was first dried of the surface water between two folders of filter paper and then kept in separate finger bowls containing slides at their bottom. At the end of the treatment period the bowls were filled with filtered

seawater and spore counts were made at 2 hourly intervals until no spores were liberated. The results are presented in Table 1 and Fig. 2 The following conclusions will be drawn : a) Drying in shade has not shown any accelerating effect on the shedding of spores. On the contrary, it has decreased the number of spores shed.

b) Prolonged drying irrevocably injured the plant and no longer shedding was observed.

Effect of light and dark periods on shedding : The healthy plants were subjected to a treatment of light and dark periods seperately. The following conclusions can be drawn from the results presented in Table 2 : a) The number of spores shed from the plant which has been in the lighted condition is more than that from a dark condition. b) There is not much difference in the number of spores shed in the lighted condttion from that in the control.

Spore out put per plant : The number of spores shed from one well-developed plant in one season (October-November) was calculated from the results of the previous experiments. It has been calculated to be about 2×10^4 spores per plant per season at Jaleswar reef, Veraval.

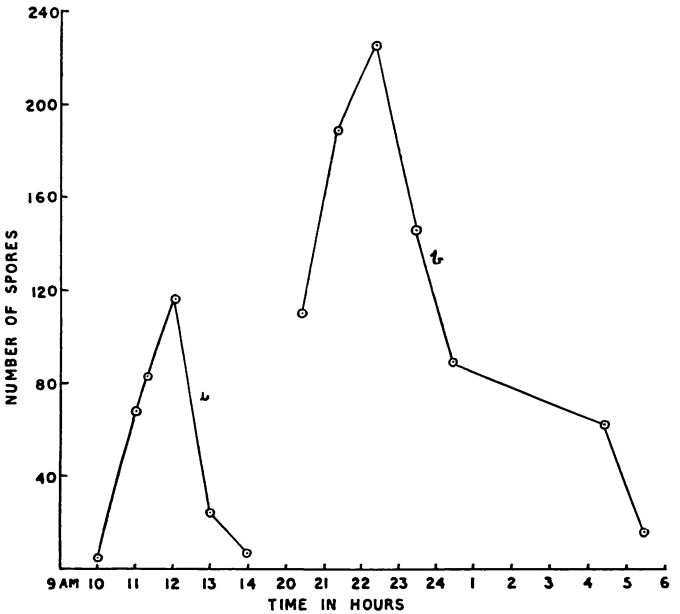

Fig. 1. Diurnal variation of shedding of tetraspores counted in a day in plants collected a) in the morning and b) evening after exposure on 5th October, 1970.

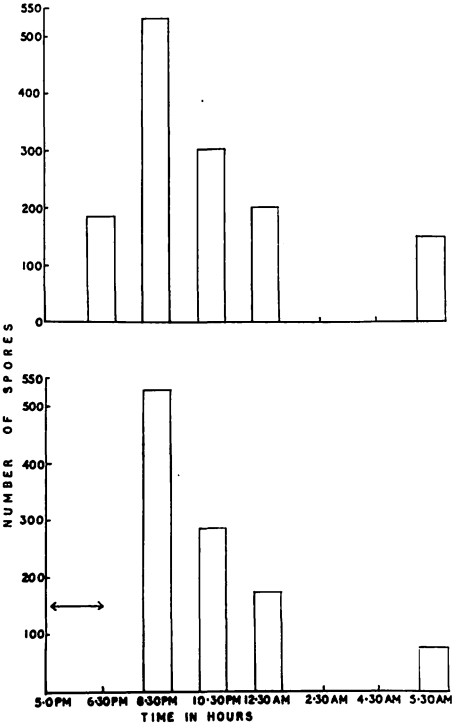

Fig. 2. Effect of drying in shade on the shedding of tetraspores as expressed by the number of spores counted ; upper histogram shows the count made from the plant kept under normal conditions and lower histograms shows the count made in plant subjected to 1½ hours of drying in shade.

Fixing : A number of slides with spores were used for finding the time of fixing of spores. Such slides were examined at every 5 minutes, after flooding the slides with fresh seawater, to wash off the non-adherent spores. By this method it was found that most of the spores adhered to the slides within a period of 10–15 minutes.

It was also found that the spores do not show any selectivity in fixing for oyster shells, glass slides, nylon or coir threads kept in bowls of water in the laboratory. However, they were not strongly fixed on the glass slides as compared to shells or other types of substrata.

DISCUSSION

SUTO[2]working with *Gelidium* found that shedding of spores occurred daily in the afternoon. But KATADA[4] observed that the shedding was not restricted to afternoon but varied depending on the temperature of the seawater. But in the present case it has been found that shedding is not related to the time of the day but is related to the time of exposure and flooding of the tide-pool.

The absence of liberated spores in pool water during the exposure of the tide-pool and shedding of spores in the laboratory plants collected at the end of exposure period, clearly indicate that shedding occurs during the flooding of seawater after exposure. Further, the increase in the shedding of, spores from plants collected after the afternoon exposure than the morning exposure, indicates that the shedding is related to time of exposure as also to the combined effect of accumalating effect of light as suggested by SUTO[2,5] and the water temperature as suggested by KATADA[4] for *Gelidium*.

Table 1 : Effect of drying in the shade on the shedding of tetraspores in *Gelidiella acerosa* (FORSSKÅL) FELDMANN et HAMEL expressed by the number of spores counted on 7-10-1967

Time in hours	Time of drying in shade					
	Non-drying	1 hr.	2 hrs.	4 hrs.	6 hrs.	12 hrs.
5.00-						
5.00- 6.30P.M.	186					
6.30- 8.30P.M.	486	536				
8.30-10.30P.M.	306	286	6			
10.30-12.30A.M.	203	174	0	0		
12.30- 5.30A.M.	150	86	0	0	0	
5.30- 7.30A.M.	0	0	0	0	0	0
7.30- 9.30A.M.	0	0	0	0	0	0
9.30-11.30A.M.	0	0	0	0	0	0

Table 2 : Effect of lighted and dark condition on the shedding of tetraspores in *Gelidiella acerosa* (FORSSKÅL) FELDMANN et HAMEL expressed by the number of spores counted on 8. 10. 1967

Time in hours	Treatment		
	Control	Lighted condition	Dark condition
5.30-			
5.30- 7.30P.M.	140	156	171
7.30- 9.30P.M.	502	450	10
9.30-11.30P.M.	83	57	2
11.30- 1.30A.M.	18	6	0
1.30- 3.30A.M.	4	0	0
3.30- 5.30A.M.	0	0	0

ACKNOWLEDGEMENTS

The author is thankful to Dr. C. S. Prakasa Rao for his valuable guidance during the course of the study. Grateful acknowledements are made to Dr. D. S. Datar of Central

Salt and Marine Chemical Research Institute, Bhavnagar, for providing all facilities in the field and laboratory work and generous encouragment. Thanks are due to Dr. SUTO of Tokai Regional Research Laboratory Tokyo, for acquainting the author in the techniques used in the study, during his stay in Japan.

SUMMARY

It has been observed that *Gelidiella acerosa* (FORSSKÅL) FELDMANN et HAMEL has two spore-shedding seasons in an year, first shedding during April-May and second during October-November. The shedding period was observed to extend over 25 to 30 days in an year. Further it has been observed that (a) the shedding of spores during the two sheddings in a day are unequal, (b) spores are shed when plants are covered by fresh seawater after exposure, (c) drying of the fertile ramuli does not induce shedding, (d) the peak for spore shedding is observed to be at the beginning of the shedding period, (e) spores may fix on to the substratum 15 minutes after they come in contact with it, (f) the spore output of an average-sized plant per season has been calculated to be 2×10^4 tetraspores.

Literature cited

1. SUTO, S. (1950) Studies on a counting method of spores in sea. Bull. Jap. Soc. Sci. Fish. **15** : 674-677 (Japanese)
2. _____ (1950) Studies on shedding, swimming and fixfng of spores of seaweeds. *Ibid.* **16** : 1-9 (Japanese)
3. KATADA, M., MATSUI, T. et al. (1953) Studies on the propagation of Gelidium V. On the shedding of the spores of *Gelidium amansii* LMX. (1) Bull. Jap. Soc. Sci. Fish. **19** : 371-473 (Japanese)
4. KATADA, M. (1955) Fundamental studies on the propagation of gelidiaceous algae with special reference to shedding and adhesion of the spores, germination growth and vegetative reproduction. J. Shim. Col. Fish. **5** : 1-87 (Japanese)
5. SUTO, S. (1950) Shedding, floating and fixing of the spores of the *Gelidium*. Bull. Jap. Soc. Sci. Fish. **15** : 671-673 (Japanese)