ON THE DEVELOPMENT OF TETRASPORES OF *ACANTHOPHORA SPICIFERA* (RHODOMELACEAE — RHODOPHYTA)

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ABSTRACT

A detailed description of tetraspore development in *Acanthophora spicifera* is presented together with a discussion of the importance of temperature and the ripeness of spores. A slight modification of the tradicional methods of spore culture is suggested. It was concluded that the developmental pattern of *A. spicifera* is exactly the same as that described in the literature for the other members of the *Rhodomelaceae*.

INTRODUCTION

The importance of studies on the development of algal spores has been increasingly realised by Phycologists as an aid to taxonomy. Recently several authors (FELDMANN 1938, CHIHARA & KAMURA 1963, KAMURA 1963) have used spore development pattern to elucidate the systematic position of some confused genera. In spite of the fact that studies on the development of spores were iniciated more than one hundred years ago (AGARDH 1836) the avaiable information is still inadequate to permit generalizations. This become self evident when the different classifications based on developmental patterns are examined: OLTMANNS (1904-5), KILLIAN (1914), KYLIN (1917), CHEMIN (1937), INOH (1947), BOILLOT (1961).

MATERIALS and METHODS

Culture studies were made on *A. spicifera* (VAHL) BÖRGESEN, found abundantly on the shores of the state of São Paulo (Bra-

zil). The work was carried out in the laboratory of the INSTITUTO OCEANOGRAFICO da UNIVERSIDADE de SÃO PAULO, near UBATUBA, in December 1963, when this alga was found with tetrasporangia. The techniques recomended by CHEMIN (1937) were used with the following modifications: 1) the plants were well washed in previously boiled brine to prevent contamination; 2) under a dissecting microscope the fertile branchs were cut and transfered to a slide in a drop of sea water; 3) the slides were then put in a large translucente box (wet chamber); 4) after the elimination of spores the branches were removed.

By this simple method the examination of living material under the microscope became both easy and rapid. If a certain developmental stage was found to be of interest it was preserved for subsequent observations sealed with a drop of aceto-carmine under a coverslip.

With this method, only the early stages of development were obtained. To obtain further stages these slides, (with the sporeling already fixed to the glass) were placed in a jar with sea water.

The entire experiment was carried out at temperatures between 22°C and 26°C.

RESULTS

The tetraspores just after elimination had a diameter of 58 to 75 micra. One or two hours later they attached themselves to the substratum and began to produce an unpigmented protuberance. Three to five hours later, a cellular wall isolates this cilindrical protuberances from the original spore cell. In this 2 celled sporeling the cell wich will give rise to the thallus (thallus initial), and that wich will form the rhizoids (initial rhizoidal), Figs. 2 and 3, can already be identified.

Seven to nine hours later, the rhizoidal cell continued to elongate and the thallus initial began to divide perpendicularly to its axis, forming 5 to 6 cells. Figs 5-7.

Until this stage the plant is uniseriated; after the 5 to 6 cell stage is attained, these cells begin to divide parallel to the axis of

the sporeling, with the exception of the apical cell (14 to 17 hours) Figs. 8 and 9.

As the cells become increasingly numerous their relative size decreases indicating that the velocity of the cell division is greater than the growth of the cells. Figs 1 to 4 and 17 to 18.

In more advanced stages the characteristic polysiphonic structure of the *Rhodomelaceae* can already be observed.

In the subapical cell there often occurs a cylindrical out-growth (Figs. 15, 18 and 19) thought to be a pluricellular trichoblast.

At the same time that the thallus is growing, the rhizoidal cells elongate and divides perpendicularly to their axes, presenting frequently a discoidal expansion with small cells distally. Studies on the influence of light in spore development were not made, however it was noted that direct sunlight made the sporeling grow pale and to disintegrate.

In conclusion it was observed that the development of the tetraspores of *A. spicifera* is exactly the same refered to in the literature for the other *Rhodomelaceae* already studied, and so belongs to the "AUFRECHT TYPUS" of OLTMANNS (1904-5), KILLIAN (1914), KYLIN (1917), or the "TYPE CERAMIUM" of CHEMIN (1937), or "TYPE ERECT AVEC UNE INITIALE" of BOILLOT (1961).

DISCUSSION

The importance of temperature when timing the development of spores seems evident. Therefore data on the timing of stages without information on the temperatures is undesirable. When timing the developmental stages, great care must be taken with the ripeness of the spores, because the tetrasporangia probably will not ripen at the same time. The problem of contamination of the cultures by bacteria, protozoa and so on, can be serious if the usual precautions are not taken.

In our cultures the presence of some sporeling was noted, the development of wich differed from the most of the others Figs. 20-21. These sporelings had no defined pattern of development. CHEMIN (1937) has already noted these "abnormal sporelings"

and suggests that they are due to spores eliminated before they were completely mature. It is suggested here that this "abnormality" may also be a problem of genetical, physical or chemical nature, such as temperature, salinity and contamination, resulting from the artificial conditions of the experiment.

It is thought therefore that much more work is needed on this field, but such work must be elaborated using large number of spores, and if possible, at a constant temperature.

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RESUMO

O trabalho apresenta uma descrição detalhada e numerosas figuras sôbre a germinação de tetrásporos de *Acanthophora spicifera,* e introdus algumas modificações nas técnicas usualmente empregadas. Discute também a importância da temperatura e do grau de maturação dos esporos em tais estudos. Os dados observados concordam com o padrão de germinação das demais espécies de *Rhodomelaceae* já estudadas.

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PLATE I

Fig. 1 — Spore just after liberation from the tetrasporangium.
Fig. 2 — Protuberance formation that later will produce the rhyzoid.
Figs. 3-7 — Sequence of the segmentation of the sporeling; the divisions are perpendicular to the sporeling long axis.
Fig. 8 — First parallel divisions to the long axis of the sporeling.
Figs. 9-11 — Ordenate sequence of sporeling's development (later stages of this same sequence are depicted on plate II).
Figs. 20-21 — Abnormal sporelings.

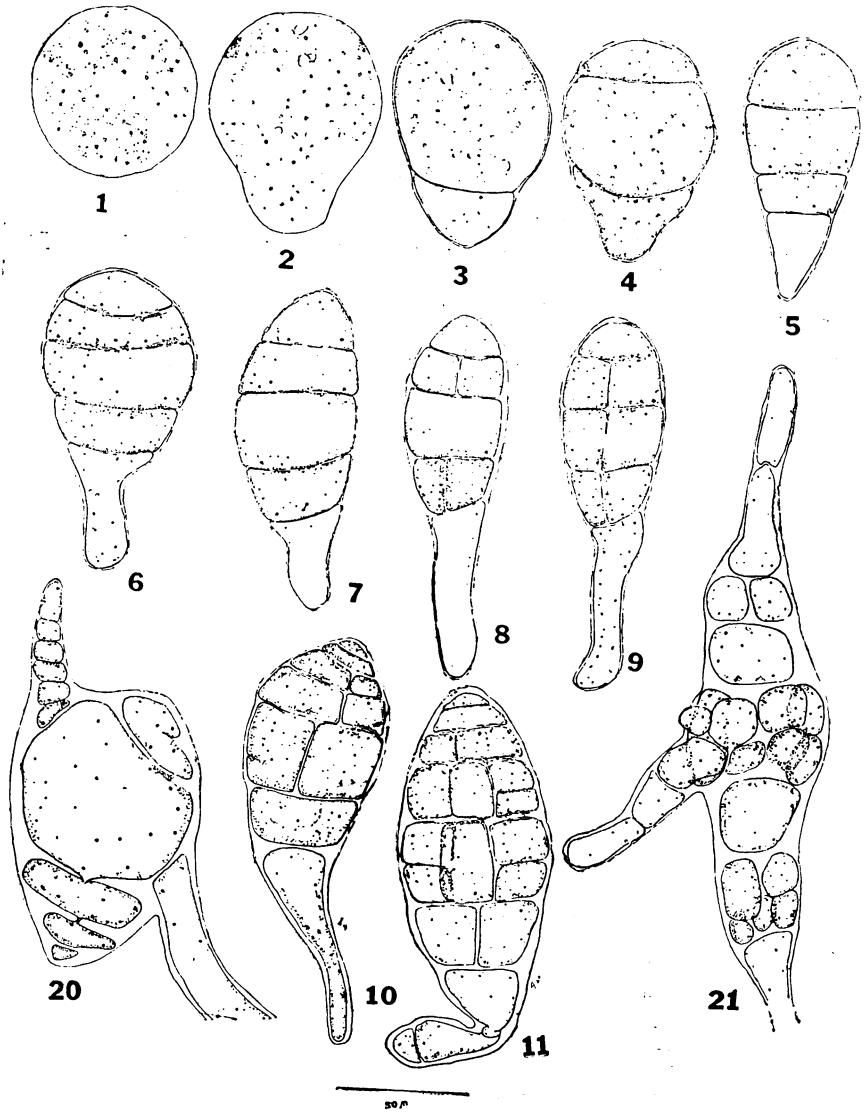
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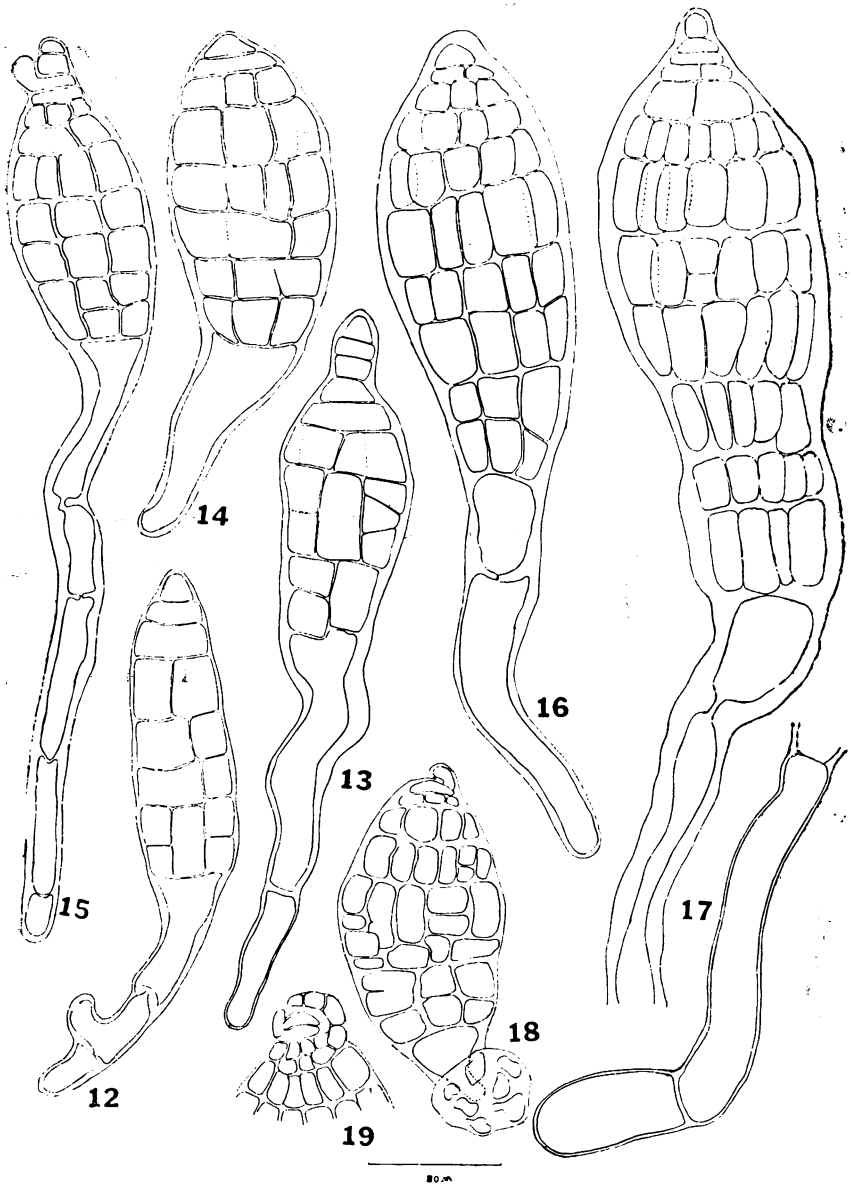
PLATE II

Figs. 12-19 — Ordenate sequence of sporeling's development.
Fig. 18 — Disc of fixation.
Fig. 19 — Begining of thricoblast formation (also figs. 15 and 18).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