A COMPARATIVE STUDY OF THE INTERCELLULAR CONNECTIONS BETWEEN PARASITE AND HOST IN TWO *GELIDIOCOLAX (GELIDIACEAE?, RHODOPHYTA)/GELIDIUM (GELIDIACEAE, RHODOPHYTA)* ALGAL PARASITIC SYSTEMS

by

JUAN ANTONIO SEOANE CAMBA*

Resumen

SEOANE CAMBA, J.A. (1996). Estudio comparativo de las conexiones intercelulares entre parásito y huésped en dos Gelidiocolax (Gelidiaceae?, Rhodophyta)/Gelidium (Gelidiaceae, Rhodophyta) sistemas parasíticos algales. *Anales Jard. Bot. Madrid* 54: 50-54 (en inglés).

El estudio ultraestructural comparativo de las conexiones intercelulares parásito/huésped, entre dos sistemas parasíticos, *Gelidiocolax christianae* Feldmann y Feldmann/*Gelidium spathulatum* (Kütz.) Bornet y *Gelidiocolax deformans* Seoane Camba/*Gelidium sesquipedale* (Clem.) Thur., ha puesto de manifiesto diferencias cualitativas y estructurales. El número de células intermediarias (antes de la fusión con las células adyacentes del huésped) y el número de sinapsis complejas encontradas en uno y otro sistema son muy diferentes. La estructura fibrilar de la pared celular de las células intermediarias y la estructura lamelar del tapón sináptico son también diferentes en los dos sistemas. Se propone una hipótesis sobre la diferente actividad de las paredes celulares de las células intermediarias de los dos sistemas parasíticos, relacionada ésta con la diferente estructura.

Palabras clave: *Rhodophyta, Gelidiocolax, Gelidium*, sinapsis, sinapsis complejas, algas parásitas.

Abstract

SEOANE CAMBA, J.A. (1996). A comparative study of the intercellular connections between parasite and host in two Gelidiocolax (Gelidiaceae?, Rhodophyta)/Gelidium (Gelidiaceae, Rhodophyta) algal parasitic systems. *Anales Jard. Bot. Madrid* 54: 50-54.

Comparative ultrastructural study of the intercellular connections between parasite and host cells in two algal parasitic systems, *Gelidiocolax christianae* Feldmann & Feldmann/*Gelidium spathulatum* (Kütz.) Bornet and *Gelidiocolax deformans* Seoane Camba/*Gelidium sesquipedale* (Clem.) Thur. shows quantitative and structural differences. The number of free conjunctor cells (before fusion with the adjacent host cells) differs between the two parasitic systems and is inversely related to the number of complex pit connections. The fibrillar cell wall structure of the conjunctor cells and the lamellar structure of the complex pit plugs in the two systems are also different. A hypothesis concerning the different activity of the conjuntor cell wall in the two parasitic systems, related with the different structural appearance, is proposed.

Key words: *Rhodophyta, Gelidiocolax, Gelidium*, pit connection, complex pit connection, parasitic algae.

* Department of Botany, Faculty of Pharmacy, University of Barcelona. E-08028 Barcelona.

INTRODUCTION

A previous ultrastructural study of the pasasitic system *Gelidiocolax deformans* Seoane Camba/*Gelidium sesquipedale* (Clem.) Thur. has shown that, although the parasite *Gelidiocolax deformans* may be alloparasite according to the concept of FELDMANN & FELDMANN (1958, 1963), it forms secondary pit connections between parasite and host cells. However, these pit connections are very different from those found between normal adjacent cells in both parasite and host thallus. They have been defined as complex pit connections (SEOANE CAMBA, 1989).

With the purpose of determining whether such complex pit connections are present in *Gelidiocolax christianae* Feldmann, a comparative study was carried out in two algal parasitical systems, *Gelidiocolax deformans/Gelidium sesquipedale* (Clem.) Thur. and *Gelidiocolax christianae/Gelidium spathulatum* (Kütz.) Born.

MATERIAL AND METHODS

Parasitized material of *Gelidium spathulatum* was collected at Blanes and Tossa de Mar (Mediterranean coasts of Spain) in February and December 1988. *Gelidium sesquipedale* was collected at San Vicente de la Barquera (Atlantic coast) in April and August 1986 and 1987.

All the material used was fixed with 3% glutaraldehyde buffer (Sodium cacodylate 0.025 M) at 4 ºC and postfixed with 1% osmium tetroxide buffer. This was followed by dehydratation in ethanol and embedding in araldite (Durcupan ACM from Fluka). The sections were stained with lead citrate and uranyl acetate, prepared according to REYNOLDS (1963).

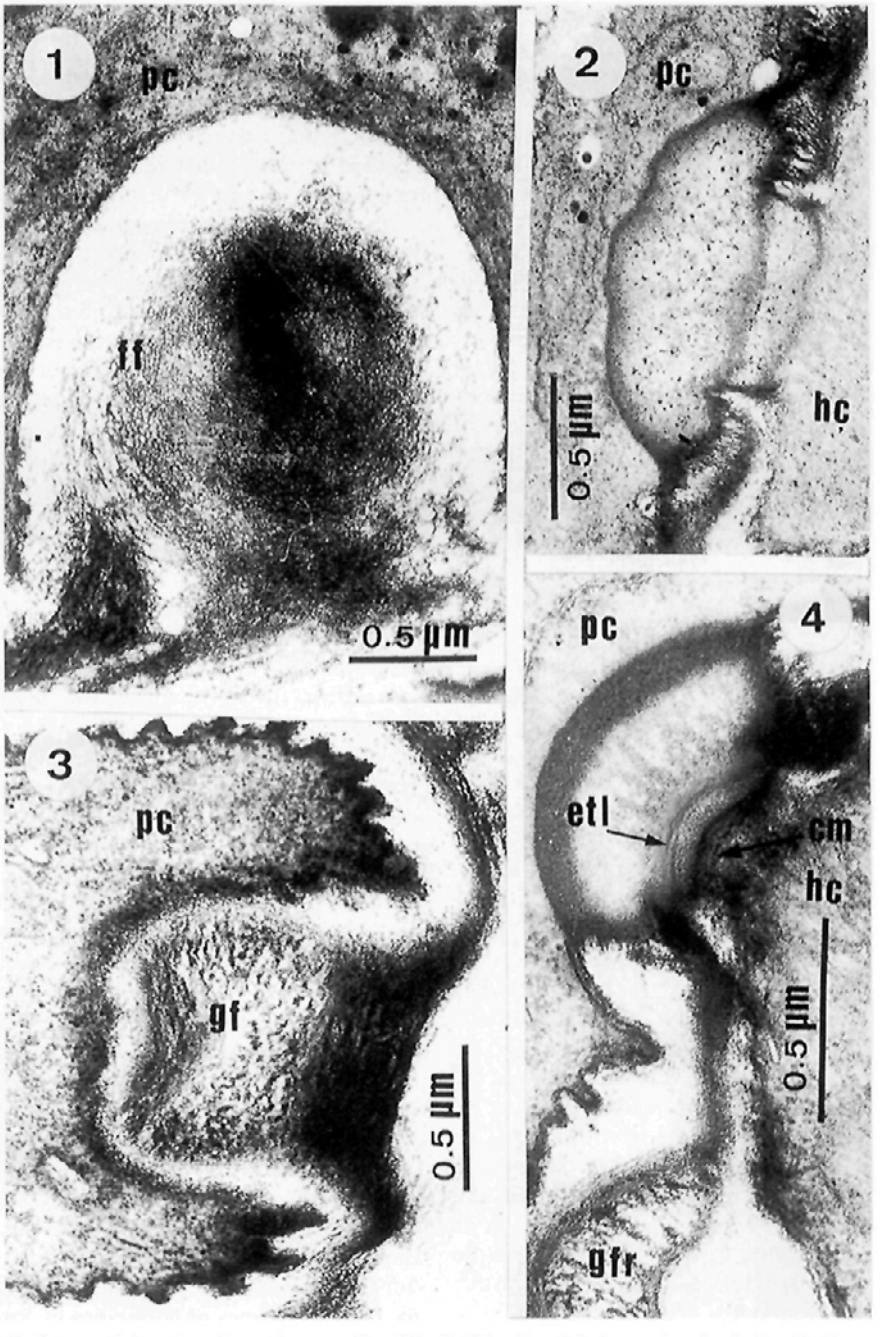
Different observations were performed on up to twenty specimens of each algal parasitic system.

RESULTS

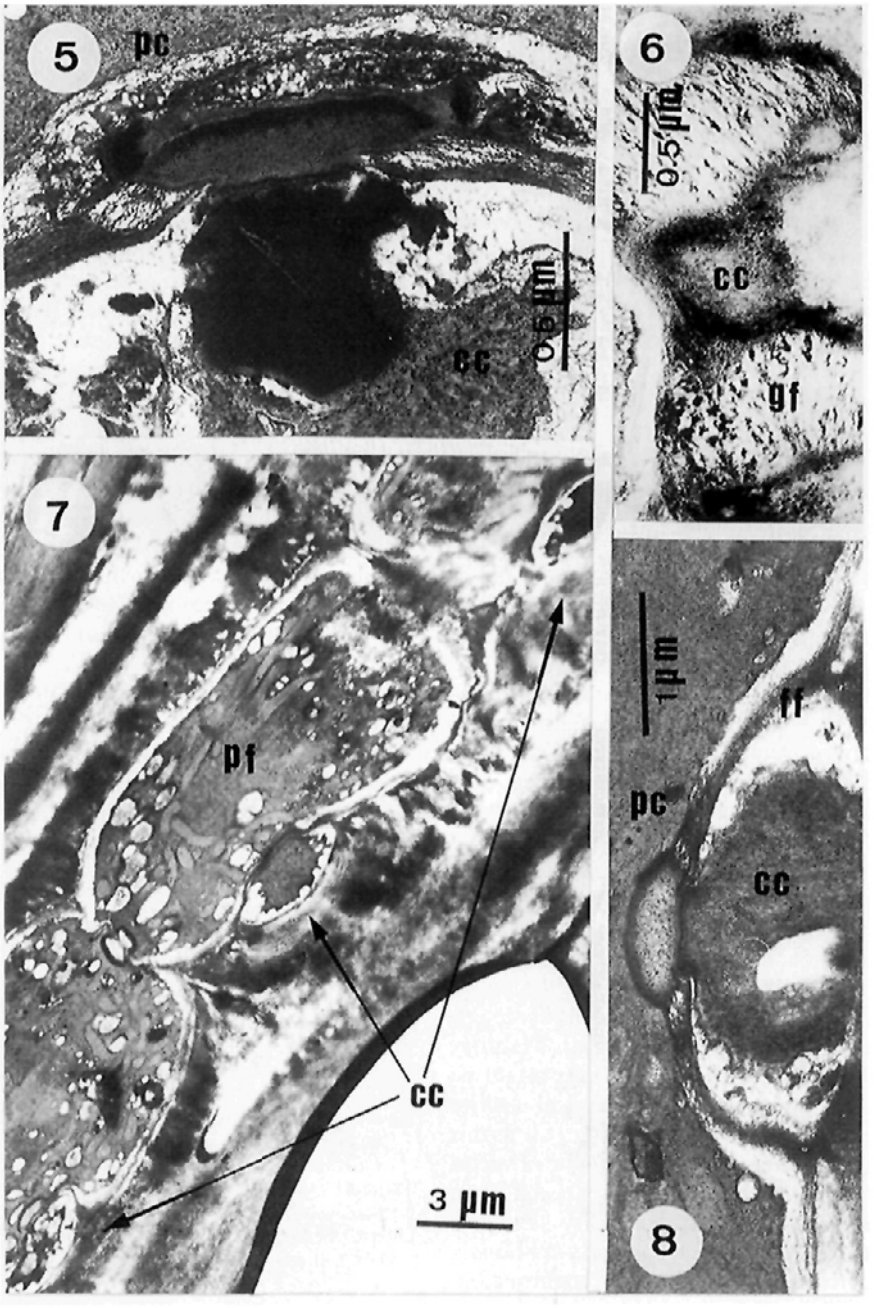
Complex pit connections are easily visible in the parasitic system *Gelidiocolax christianae/Gelidium spathulatum* (fig. 2). They are similar, but not identical, to those found in the system *Gelidiocolax deformans/Gelidium sesquipedale* (fig. 4). The most striking differences found between the two types can be studied from two different points of view: quantitative and ultrastructural.

From the quantitative point of view the number of conjunctor cells (before fusion with the adjacent host cells) is relatively high in *Gelidiocolax christianae/Gelidium spathulatum*, and the cells are sometimes observed forming series (fig.7), which has not been observed in *Gelidiocolax deformans/Gelidium sesquipedale*. On the other hand, the complex pit connections, i.e. the conjunctor cells after fusion with the adjacent host cells, are scarcely observed in *Gelidiocolax christianae/Gelidium spathulatum*, whereas they are relatively abundant in *Gelidiocolax deformans/Gelidium sesquipedale*.

From the ultrastructural point of view there are important differences between the two systems: *a)* the fibrillar structure of the cell wall of the conjunctor cell in *Gelidiocolax christianae* is built with fine fibrils, which are very similar or identical to those found in the cell wall of all vegetative cells of the parasite thallus (figs. 1, 8). However, such a fibrillar structure is formed with coarse fibrils, very different from those of the vegetative cell wall of the parasite *Gelidiocolax deformans* (figs. 3, 6). This gross fibrillar structure is visible as fibrillar remnants between host and parasite cell walls after fusion (fig. 4); *b)* the complex pit plugs themselves are differ between the two parasitic systems. While there is always an electron-transparent lamella between the two zones of the complex pit plugs in *Gelidiocolax deformans/Gelidium sesquipedale* (fig. 4) as has been described previously (SEOANE CAMBA, 1989), this structure is not evident in *Gelidiocolax christianae/Gelidium spathulatum; c)* the same can be said of the cap membranes of both types of complex pit connections, which are present in the host zone in *Gelidiocolax deformans/Gelidium sesquipedale* (fig. 4), but not clearly observed in any zone in *Gelidiocolax christianae/Gelidium spathulatum* (fig. 2).



Figs. 1-4.–1, tangential section of a conjunctor cell wall in *Gelidiocolax christianae*, showing its fine fibrillar structure (ff); 2, a typical complex pit connection in the *Gelidiocolax christianae*/*Gelidium spathulatum* algal parasitic system; 3, tangential section of a conjunctor cell wall in *Gelidiocolax deformans*, showing its gross fibrillar structure (gf); 4, a typical complex pit connection in the *Gelidiocolax deformans*/*Gelidium sesquipedale* algal parasitic system. (ff = fine fibrils; gf = coarse fibrils; pc = parasite cell; hc = host cell; etl = electron-transparent lamella; gfr = coarse fibrillar remnants; pf = parasite filament; cm = cap membrane; cc = conjunctor cell.)



Figs. 5-8.–5, conjunctor cell of *Gelidiocolax christianae* in the degeneration stage; 6, conjunctor cell of *Gelidiocolax deformans* showing the gross fibrillar structure of its cell wall (the section does not include the pit connection); 7, filament of *Gelidiocolax christianae* (pf) running through the intercellular space of *Gelidium spathulatum*. A series of conjunctor cells (cc) can be seen arising from each cell of the filament; 8, conjunctor cell of *Gelidiocolax christianae*. The fine fibrillar structure of its cell wall (ff) can be easily observed. (ff = fine fibrils; gf = coarse fibrils; pc = parasite cell; hc = host cell; etl = electron-transparent lamella; gfr = coarse fibrillar remnants; pf = parasite filament; cm = cap membrane; cc = conjunctor cell.)

The different fibrillar structure of the cell wall of the two types of conjunctor cells, and the different lamellar structure of the complex pit plugs themselves, give a very different ultrastructural appearance to the two types of complex pit connections (figs. 2, 4).

Finally, the existence of relatively abundant degenerating conjunctor cells is remarkable in *Gelidiocolax christianae* (fig. 5), whereas these stages of degeneration were not observed in the conjunctor cells of *Gelidiocolax deformans*. This is in accordance with the existence of more conjunctor cells before fusion in the first species.

DISCUSSION

In the *Gelidiocolax deformans/Gelidium sesquipedale* parasitic system the shortage of conjunctor cells found before fusion and at the degeneration stage, together with their abundance after fusion (complex pit connections well established) seem to indicate that fusion of the conjunctor cells is quickly established in this system. In contrast, the structural pattern found in *Gelidiocolax christianae/Gelidium spathulatum*, where free conjunctor cells (before fusion) are abundant and fused conjunctor cells (complex pit connections well formed) are scarce, suggests that fusion of conjunctor cells hardly occurs in this system.

This phenomenon might be explained by the different capacity to dissolve the host's cellular wall by the conjunctor cells of the two parasites. The greater penetration ability found in *Gelidiocolax deformans* could be due to the structure and biochemical activity of the cell wall of the conjunctor cell in this species. The coarse fibrillar structure of such a wall could be the structural expression of an enzymatic-biochemical activity stronger, than that found in *Gelidiocolax christianae*, although this assertion requires confirmation.

The abundance of free conjunctor cells, often in series, seems to be characteristic of *Gelidiocolax christianae*, and might be considered as a means of compensating for its lower penetration efficiency.

The apparent absense of a clearly distinguishable lamellar structure (both interior and cap membranes) in the complex pit plugs of the *Gelidiocolax christianae/Gelidium spathulatum* system appears to be an intrinsic character of such pit connections. By contrast, this estructure is usually present in the pit-plugs of *Gelidiocolax deformans/Gelidium sesquipedale*.

Finally, the infrequence of complex pit connections in *Gelidiocolax chistianae/Gelidium spathulatum* may explain why they were not observed by FELDMANN & FELDMANN (1963). This apparent absence would corroborate the hypothesis of alloparasitism for this genus, an idea proposed by FAN & PAPENFUSS (1959) and held by these authors in 1963.

ACKNOWLEDGEMENTS

The author thanks the staff of the Electron Microscope Service of the University of Barcelona for their skillful technical assistance.

REFERENCES

FAN, K.C. & G.F. PAPENFUSS (1959). Red algal parasites occurring on members of the Gelidiales. *Madroño* 15: 33-64.

FELDMANN, J. & G. (1958). Recherches sur quelques Floridées parasites. *Rev. Gén. Bot.* 65: 49-127.

FELDMANN, J. & G. (1963). Une nouvelle espèce de Floridée parasite du genre Gelidiocolax Gardner. *Rev. Gén. Bot.* 70: 557-571.

REYNOLDS, E.S. (1963). The use of lead citrate at high pH as an electron opaque stain in electron microscopy. *J. Cell Biol.* 17: 208-212.

SEOANE CAMBA, J.A. (1989). Origine et structure des synapses secondaires entre cellules du parasite Gelidiocolax deformans (Gelidiacées?, Rhodophytes) et son hôte Gelidium sesquipedale (Gelidiacées, Rhodophytes). *Cryptog. Algol.* 10: 259-271.