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Epiphytic relationships of *Pseudendoclonium submarinum* Wille (Ulvophyceae) and *Rhodymenia pseudopalmata* (Rhodophyta) from the Patagonian coast of Argentina

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SUMMARY

The occurrence of the epiphyte alga *Pseudendoclonium submarinum* Wille (Ulvophyceae) on *Rhodymenia pseudopalmata* (Lamouroux) Silva (Rhodophyta) is reported. The present study describes a first line of evidence of an epidemiological study conducted with the purpose of comparing both the prevalence and effects of algal epiphytic organisms in *R. pseudopalmata* in the Patagonian coasts of Argentina. *P. submarinum* infected approximately 80% of *R. pseudopalmata* thalli and the frequency of infection was variable in connection with different areas of the host's thalli: 42% of *R. pseudopalmata* fronds presented *P. submarinum* thalli in the basal region, which presented a severity degree of infection from low to high. The median region presented an average frequency of infection of 30% and minor susceptibility to colonization. The covering varied from 1% to 70% representing a low to moderate degree of colonization. The apical region presented a cover frequency of 28% and the level of infection varied between low to moderate. The developmental morphology and the growth dynamics of the epiphyte were also investigated under unialgal as well as bialgal culture conditions. In nature, thalli of *P. submarinum* on *R. pseudopalmata* never invaded internal tissues of the host. Vegetative thalli of *P. submarinum* were inoculated on fronds *R. pseudopalmata*. Experimental infections confirmed that *P. submarinum* thalli did not penetrate the host's fronds. *P. submarinum* swarmers showed the capacity of settlement on a host's fronds and developed an epiphytic monostromatic thallus. The results allowed us to suggest that *P. submarinum* uses the *R. pseudopalmata* thalli as a proper substrate, since *Pseudendoclonium* thalli complete the entire life cycle. Culture experiments revealed that *P. submarinum* could develop without the presence of the host and evidenced the nutritional independence, being the relationship in nature, probably triggered by an ecological advantage since fronds of *R. pseudopalmata* offer a suitable substratum.

Key words: algal epiphytism, *Pseudendoclonoim submarinum*, *Rhodymenia pseudopalmata*, symbiosis.

INTRODUCTION

The occurrence of algal species growing on or within other algae has been widely reported (Goff 1982b; Ducker & Knox 1984; Correa *et al.* 1988, 1993; Correa 1990; Correa & McLachlan 1991, 1992, 1994). Symbiosis has originally been defined as the living together of dissimilarly named organisms (De Bary 1879), whereas endo – epiphytism has been defined as a type of symbiosis in which an organism lives within, or covering the tissues of a plant host (Correa *et al.* 1988). Other authors, such as Lewis (1973), Starr (1975), Lewin (1982), Goff (1982a), Smith and Douglas (1987) and Douglas and Smith (1989) have also used the term endophytism in the same sense.

Epiphytes are usually defined as organisms that grow on plants, but do not derive nutrients from their hosts (Linskens 1976). Linskens (1963) named two kinds of ephyphytes: holo – epiphytes are those organisms attached to the outer layers of the host and amphi – epiphytes are deeply anchored in the tissues of their hosts. Linskens (1963) suggested that the type of anatomical contact is highly variable and that it is defined by the nature of the partners. In spite of the evidence indicating that both parasitism and epiphytism are common phenomena in marine algae, most of the information available between interacting species is related only to parasitism (Evans *et al.* 1973, 1978; Goff 1976, 1979, 1982a; Wetherbee & Quirk 1982a,b; Kugrens 1982; Goff & Zuccarello 1994).

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In general, epi – endophyte – pigmented algae are photosynthetically independent and with almost no metabolic relation with their hosts on account of the fact that many of these invading organisms when isolated from their hosts are capable of being cultivated subsequently under laboratory conditions (White & Boney 1969, 1970; Boney 1972; Garbary 1979; Nielsen 1987). Thus, the infection of algae by an algal organism is not an essential requisite for the existence of epi – endophytes (Sánchez *et al.* 1996). In this context, infection of a macroalga by an algal endophyte is generally considered a fortuitous event in which the association itself would not be essential for the subsistence of the endophyte. This concept has been used to explain some observed patterns of poor host-specificity (Iima & Tatewaki 1987).

On the other hand, in a number of intimate associations, it is apparent that the infecting alga does not colonize other hosts, even though they coexist with the susceptible species. This is the case of *Acrochaete operculata* Correa and Nielsen, an endophyte that causes severe destruction in *Chondrus crispus* Stackhouse, but is innocuous for *Mastocarpus stellatus* (Stackhouse) Guiry (Correa *et al.* 1988). In fact, as subsequently demonstrated, *A. operculata* proved to be a highly specific endophyte, which developed infections only when it is in contact with sporophytes of *C. crispus* (Potin *et al.* 2002).

There are also facultative epiphytes benefited from its hosts (Klochkova *et al.* 2008). This is the case of *Chlamydomonas* sp. on mixed cultures of ceramiaceaen algae, in which it grows faster than in any tested unialgal culture condition.

The genus *Rhodymenia* includes species with traditional uses in human nutrition in Ireland and Brittany and more recently marketed as a health food (Le Gall *et al.* 2004). *Rhodymenia palmata* (L.) Kuntze contains as much as 35% proteins and is a rich source of vitamins and eicosapentanoic acid (EPA) (Mishra *et al.* 1993); it was identified as one of the three red algal species with the best potential for seaweed cultivation in the north-eastern United States and Canada (Cheney 1999). Due to its high protein content (Morgan *et al.* 1980; Fleurence 1999), *Rhodymenia* spp. were considered as a good source of food for abalone in aquaculture (Evans & Langdon 2000; Rosen *et al.* 2000).

Rhodymenia pseudopalmata (Lamouroux) Silva is an important constituent of tidal and subtidal algal communities in the southern coasts of Argentina (Mendoza & Nizovoy 2000). Fronds are flattened, fan-shaped, rather stiff, light brownish-red, with long or short stipes arising from a discoid base. They are repeatedly dichotomously lobed, with wide axils, rounded apices and smooth margins.

The present study focused on the identification of the most common epiphytes infecting the hosts in a South Argentinean population of *R. pseudopalmata* with special reference to *Pseudendoclonium submarinum* Wille (Ulvophyceae), with precisions about the kind of the interaction and the relative abundance of the epiphyte. The present study describes a first line of evidence of an epidemiological study conducted with the purpose of comparing both the prevalence and effects of algal epiphytic organisms in *R. pseudopalmata* in the Patagonian coasts of Argentina.

MATERIALS AND METHODS

Sampling

Rhodymenia pseudopalmata fronds were obtained from subtidal populations of the coast of Santa Isabel (between 43°18′S and 65°06′W) in the province of Chubut, Argentina, during December 2004. A collection of 30 randomly selected fronds was used for the present research.

Identification of epi – endophytes and estimation of the severity index of infection

For the examination of thalli of *R. pseudopalmata* apical, intermediate and basal sectors were considered. Size, presence and position of epiphyte organisms and severity degree of infection were registered for each frond. In order to evaluate the severity degree of infection, a qualitative scale was used Peters and Schaffelke (1996). This scale resulted from the visual categorization of a dissection observed by light microscopy. Prevalence (i.e. percentage of thalli that were infected) and severity of infection (i.e. mean abundance of epiphytes on each host thallus) were then estimated. A ‘severity index’ was based on a semi-quantitative estimation of epiphyte cover on host thallus using four categories, where 0 = a total absence of epiphytes, 1 = 1–30% cover, 2 = 31–70% cover and 3 = 71–100% cover. The severity degree of infection was categorized as low when the percentage of host thalli colonized by epiphyte organisms ranged from 1% to 10% (i.e. no visible signs of endophytic infection were observed). The severity degree of infection was categorized as moderate when the percentage of colonized thalli varied from 11% to 70% (i.e. moderate alterations, such as green spots on the lamina, were observed). Finally, the severity degree of infection was categorized as high in those cases in which thalli exhibited a colonized area percentage higher than 71% (i.e. strongly invaded thalli were observed). The distinction between the categories was arbitrary. Only those thalli under the categories ‘moderate’ and ‘high’ were considered diseased.

Isolation of epi – endophytes and unialgal culture

After being collected, fronds were kept on ice, retained in labelled plastic bags until they were examined in the laboratory, usually within 5 h after collection. Fronds were brushed and rinsed under running tap water. Small portions of infected fronds were sectioned, then immersed in fresh 0.5% solution of sodium hypochlorite for 30 s, and finally rinsed three times, 5 min each, in sterile seawater. A 2 min sonication was subsequently applied to 5×5 mm portions in sterile seawater, renewing the seawater after each burst. This cleaning procedure was followed in order to remove diatoms as well as other epiphytes.

Pseudendoclonium submarinum crude cultures were initiated by inoculating portions of cleaned fronds in plastic Petri dishes containing Provasoli enriched seawater (PES) medium Provasoli (1968). Cultures were maintained at 21 ± 1°C with an illumination regime of 12 : 12 h light : dark (LD), with a photon flux density of 15 μmol m^{-2} s^{-1}. Germlings were obtained either from swarmers or from outgrowths of the endophytes from infected thalli. They were subsequently segregated into unialgal cultures and maintained under the above-mentioned conditions with weekly changes of the medium. A 2.5% germanium dioxide solution dissolved in distilled water was added to avoid diatom contamination (Lewin 1966; Christensen 1982). Adding sterilized unenriched seawater induced hair production in *P. submarinum.* Strains were maintained for 4 weeks.

Experimental infection

Infections of *R. pseudopalmata* by selected isolates of *P. submarinum* initially established from swarmers were experimentally carried out. Eight to 10 1.0–1.5 cm long fragments of fronds of the host were placed into plastic Petri dishes. Two replicates of each isolate were incubated under laboratory conditions during a period of 2–3 weeks.

Morphological studies

Cytomorphometry was carried out using a stereoscopic microscope Wild-Herbrugg (Gais, Switzerland) and an inverted microscope Nikon Eclipse TE 300 (Tokyo, Japan), with anoptral phase contrast and differential interference contrast (DIC) and with an incorporated camera Nikon FDX 35. Either the presence or absence of epiphyte filaments was determined under light microscopy in semi-thin sections of thalli of *R. pseudopalmata*. In order to obtain semithin sections, thalli were fixed in 2.5% glutaraldehyde in seawater for 2 h at 4°C, and postfixed in 1% OsO4 in sea water for 2 h at 4°C. The material was dehydrated in a graded acetone series and embedded in SPURR's low viscosity resin. Sections were obtained with glass knives on a Reicher Ultracut OM U2 ultramicrotome (Vienna, Austria). The resin was removed using a metallic sodium, benzene and methylic alcohol solution (Hayat 1986). Sections were stained with a combination of colorants, namely haematoxiline- malachite green-basic fucsine (1:1:1) (Berkowitz *et al.* 1968).

Chromosome counts

Chromosome counts were made using unialgal cultures of *P. submarinum*. Thalli were fixed either in 1:3 mixture glacial acetic acid/absolute ethanol or in 6:3:1 mixture formaldehyde/absolute ethanol/glacial acetic acid at 5°C during a period of 2–24 h. Postfixation was carried out with 70% ethylic alcohol. The material was subsequently hydrolyzed for 30 min in 1 N hydrochloric acid (HCL) at room temperature, stained with Schiff stain in darkness for 2 h (Johansen 1940), bleached during 20 min in a 1:3:3 mixture of sodium metasulphite: 1 N HCL: distilled water, washed with distilled water for 30 min, and finally mounted in a drop of a 2% acetic acid solution of ferric haematoxylin with added iron acetate (Núñez 1968).

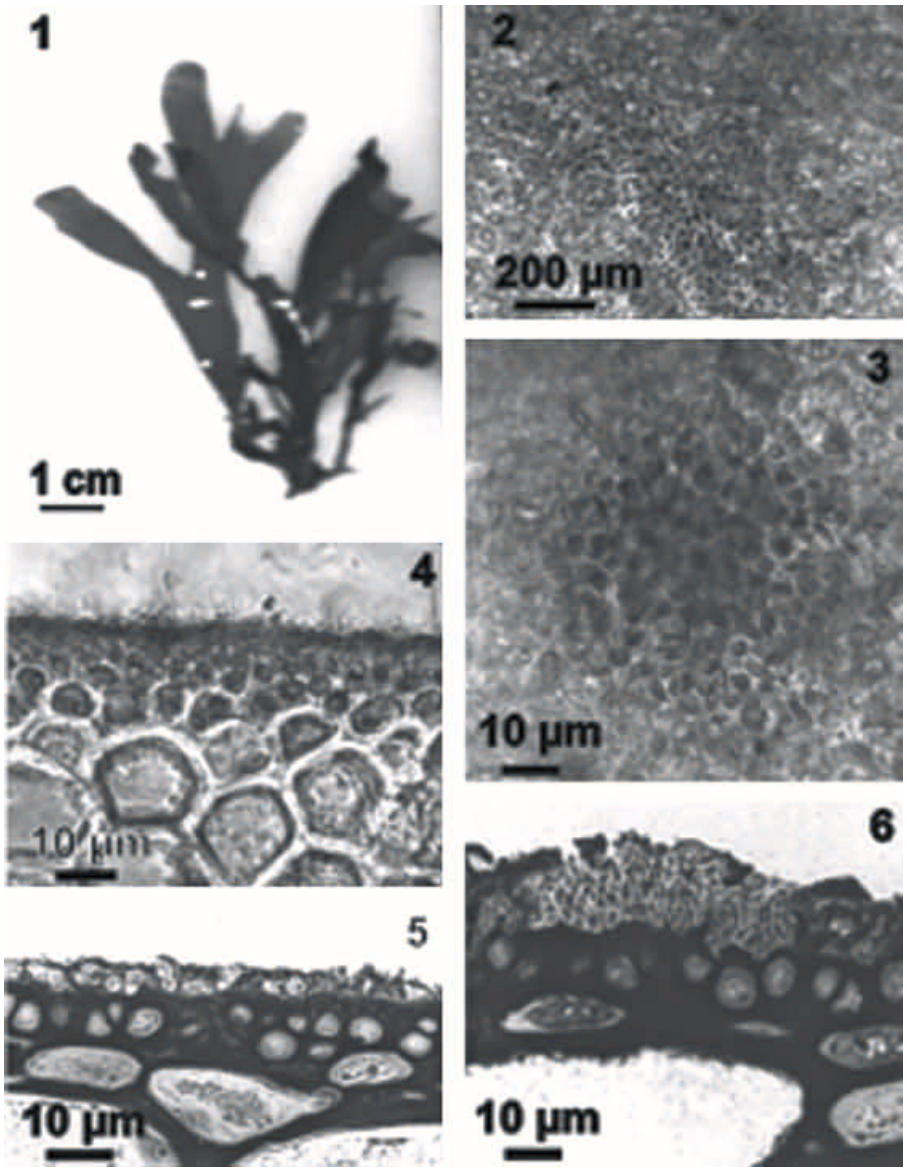
Scanning electron microscopy

Filaments of *P. submarinum* were fixed in 2.5% glutaraldehide in 0.01 M Na-cacodylate buffer (pH 7.2) at 5°C, for 2 h. They were subsequently mounted on slides covered with 0.5% poly-D-lysine and dehydrated in a graded acetone series. Samples were finally critical point dried during 1 h, coated with gold, and observed with a Jeol 35 CF scanning electron microscope (SEM).

RESULTS

Morphology of *Pseudendoclonium submarinum* developed on *Rhodymenia pseudopalmata* in nature

Infected fronds of *R. pseudopalmata* (Fig. 1) exhibited green spots, which indicated the presence of *P. submarinum* filaments, which formed green mats of not more than 1 mm in length (Fig. 2). Epiphytic thalli showed a pseudoparenchymatous central area made up of cells either spherical or ovoid, 5–8 μm diameter, with a marginal system of radially disposed, irregularly branched filaments composed of larger cells with no hairs. Cells exhibited a single, parietal chloroplast with one pyrenoid. No sporangia were observed. In earlier stages of development thalli showed short filaments composed of two to three ovoid to cylindrical cells. Later, thalli developed a polystromatic central area and radial short filaments of two to three cells (Fig. 3).



Figs 1–6. 1. General view of a *Rhodymenia pseudopalmata* thallus. 2. View of an epiphytic thallus of *Pseudendoclonium submarinum.* 3. Detail of thallus *P. submarinum* showing a pseudoparenchymatous central area, with a marginal system of radially disposed, irregularly branched filaments composed of larger cells with no hairs. 4. Section of a field-collected, living frond of *R. pseudopalmata* showing epiphytic filaments of *P. submarinum* on its surface. Note it does not penetrate either of the cortical or medullar regions. 5. Semi-thin section of a fixed thallus of *R. pseudopalmata* infected with an epiphytic thallus of *P. submarinum*. The cells of *P. submarinum* are distributed on the host's surface without developing an erect system. 6. Incipient erect system of *P. submarinum* on *R. pseudopalmata* producing a rupture of the epidermic and subcortical regions.

Semi-thin sections of *R. pseudopalmata* blades showed that *P. submarinum* cells remained outside the cuticle, without penetrating cortical or medullar regions of the host (Fig. 4). *P. submarinum* cells were distributed on the host's surface without developing an erect system (Fig. 4,5). Occasionally, nevertheless, a tight and incipient erect system, constituted by few cells, reached the cells of the outer cortical area of the host's tissues and ruptured the epidermic region (Fig. 6).

Prevalence and severity index of infections

The presence of *P. submarinum* on natural populations of *R. pseudopalmata* was common since approximately 80% of the thalli were infected independently of the thalli sizes. The frequency of infection of *R. pseudopalmata* fronds was, nevertheless, variable in connection with different areas of the host's thalli. Near to primary branches, 42% of *R. pseudopalmata* fronds were infected with *P. submarinum* thalli in the basal region, with severity degrees of infection from low to high. The median region of the thallus presented an average frequency of infection of 30% and was the area with minor susceptibility to colonization. The percentages of covering in this region varied from 1% to 70%, representing a region with low to moderate degrees of colonization. The apical region of the examined fronds presented a cover frequency of 28%. The level of infection changed between low to moderate, reaching some thalli strong symptoms of epiphytism. In general, 33% of the examined thallus presented low severity degree of infection, 47% moderate, and 20% high.

Experimental infection

Pseudendoclonium submarinum thalli were inoculated *in vitro* on fronds with *R. pseudopalmata.* Under culture conditions, they developed normally, never penetrating tissues of the host's fronds. The swarmers formed in this thalli, and were capable of settling on culture dishes and also on *R. pseudopalmata* fronds. After settlement, swarmers germinated and developed epiphytic, monostromatic thalli on the host's surface. These thalli exhibited radiate, irregularly branched filaments; some of them were free toward the periphery. Cells in the periphery were 5–9 μm wide, and three to four times longer than wide. Cells of the central area were shorter and isodiametric. Later, thalli acquired a pseudoparenchymatous structure with cells very much alike those of initial cultures.

Development and morphology of free thalli of *P. submarinum* in culture

Under culture conditions, filamentous thalli were initially prostrate. Later they developed into erect, irregularly branched, 4–10-celled filaments. Normally, these thalli showed a tangled appearance with no hairs (Fig. 7). Cells were cylindrical 5.8 ± 2.4 μm (3.4–14.6) μm ($n = 35$) in diameter and (–2), 3–4 (–8) times longer than the cell diameter. Cells contained a nucleus and a parietal, reticulated chloroplast with a pyrenoid (Fig. 8). Thalli polymorphism occurred, since we observed: (i) monostromatic, pseudoparenchymatous thalli with ovoid cells (Fig. 9), (ii) thalli with a central area, occasionally with few free filaments of oval cells growing from it (Figs 10,11) and also (iii) free thalli formed by filaments with few ramifications and elongated cells (Fig. 12). Cells of all types of thalli had a rough cell wall (Fig. 12).

Zoosporangia development in thalli of *P. submarinum* in culture

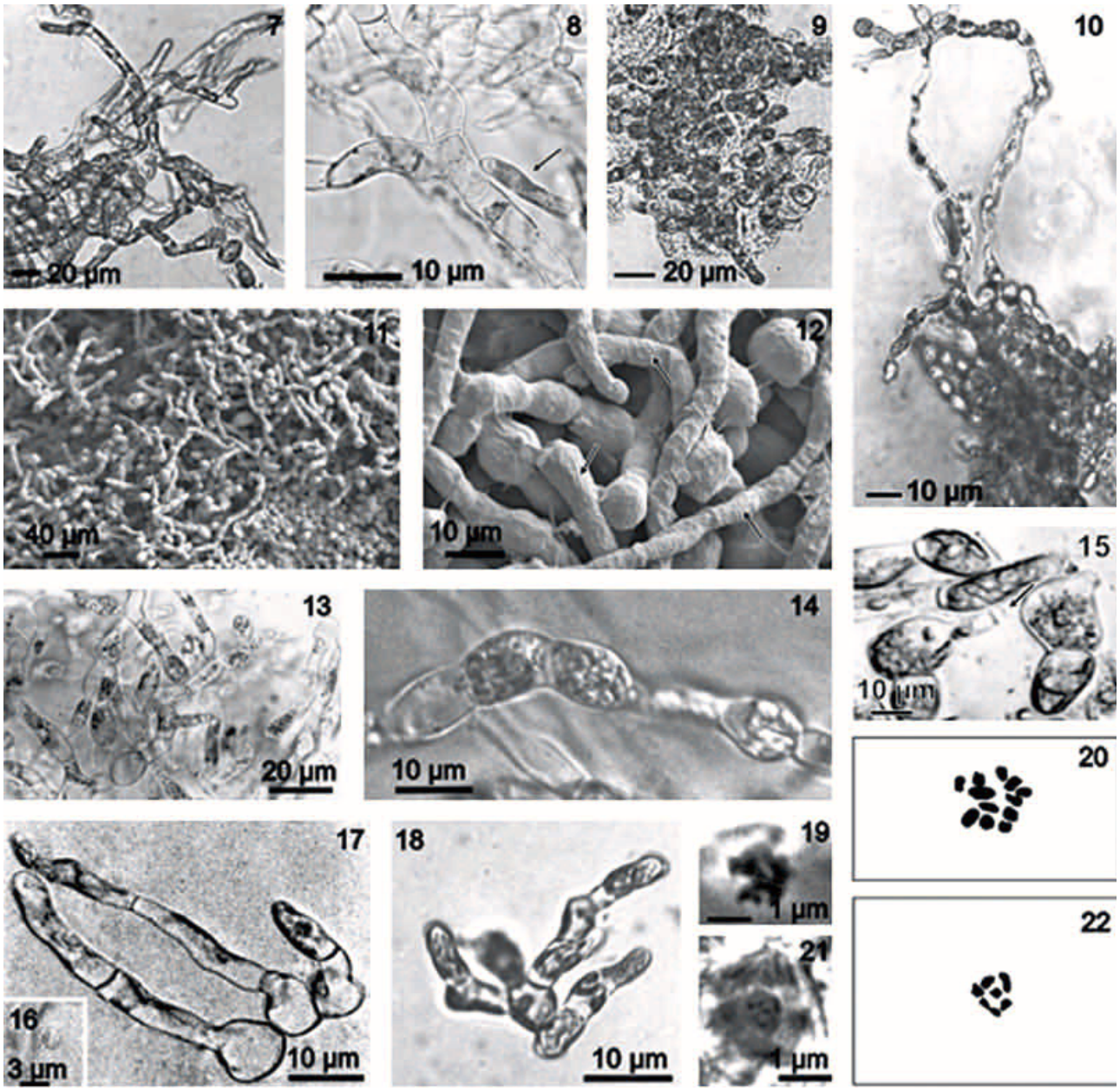
After transferring thalli to a fresh medium, both terminal and intercalary sporangia developed within a few days from vegetative cells of the central area (Fig. 13). Mother cells elongated conspicuously at the initial stages of sporangia development, thus both types of sporangia, terminal and intercalary, were longer and broader than vegetative cells. They were 17.7 ± 2 μm (14.7–18.9) μm ($n = 10$) long and 6.3 ± 1 μm (5.1–7.4) μm ($n = 10$) wide (Fig. 14). When mature, sporangia developed a conical expulsion papilla (Fig. 15). Sporangia formed either 16 or 32 swarmers (Fig. 16). Both biflagellate and quadriflagellate swarmers were produced in different sporangia on the same thalli. Quadriflagellate swarmers varied from pyriform to nearly spherical, and they were 4–5 μm wide × 5–7 μm long ($n = 15$). Biflagellate swarmers were pyriform 2.5 μm ± 0.7 μm in length and 2.3 μm ± 0.6 μm wide ($n = 15$). They contained a basal chloroplast with a stigma (Fig. 16). Ovoid, smaller biflagellate swarmers were also produced, 1.3 μm ± 0.2 μm in diameter ($n = 5$). All swarmers were simultaneously released from their respective zoidangia and remained mobile during a few minutes after release. Attachment to the substratum occurred for the posterior region of the swarmer and flagella were actively discarded. Germination was unipolar and a long germination tube was formed. Afterwards, postrate filaments developed (Fig. 17). After one week of development, the production of the first erect filaments took place (Fig. 18).

Kariology of *P. submarinum*

Metaphases were observed in vegetative cells of *P. submarinum* in the central area of thalli. It was registered metaphases with 2n = 12 (Figs 19,20) and $n = 6$ (Figs 21,22) chromosomes.

DISCUSSION

Numerous species of the genus *Pseudendoclonium* were registered in different parts of the world growing epiphytically on several seaweeds and aquatic plants, that is, *Pseudendoclonium fucicola* (Rosenvinge) Nielsen was registered on *Fucus vesiculosus* L. in southern Finland (Nielsen 1988), on *Fucus* spp., *Ascophyllum nodosum* (L.) Le Jolis and *Laminaria digitata* (Hudson) Lamouroux and *Laminaria* sp. from the Eastern coast of Canada (Nielsen & McLachlan 1986). *Pseudendoclonium basiliense* var. *brandii* Vischer was found on *Potamogeton pectinatus* L. and *Zostera marina* L., in southern Finland too (Nielsen 1988). Also, it was observed on *A. nodosum* and *Furcellaria lumbricalis* (Hudson) Lamouroux from Denmark and the UK (Nielsen 1984). *P. submarinum* was recorded on *Ceramium rescissum* Kylin at Nordre Rønner, Laesø, northern Kattergat, Denmark; in the littoral zone at Hirsholm, northern Kattegat; from a cave in the chalk cliffs at about the upper spring tide level at Kingsgate near Broadstairs, Kent, UK; and on wooden piles on the shore north of Saeby, central Kattegatm Denmark (Nielsen 1980). *P. submarinum* was cited by Nielsen (1988) as a very common epi – endophytes on different macroalgae, as part of algal crusts on stones, shells or woods. They are also associated with bryozoids and hydroids. In North America *P. submarinum* has been observed in Canada by Lee (1980). It was also observed in the USA, in Florida (Schneider & Searles 1991); Maine (Taylor 1957); North Carolina (Schneider & Searles 1991) and Rhode Island (Taylor 1957). In Europe it was reported in the British Isles in: Kent, Dorset, Severn Estuary, Island of Cumbrae, Isles of



Figs 7–22. 7. General aspect of a thallus of *Pseudendoclonium submarinum* under culture conditions. 8. Detail of Figure 7 showing a cell with the chloroplast against the cell wall (arrow) and the base of a ramification. 9. *P. submarinum* pseudoparenchymatous, monostromatic thallus with ovoid cells. 10. *P. submarinum* thallus showing a polistromatic area, of which arises long free periphery filaments. 11. Scanning electron microscopy (SEM) photomicrography showing the general aspect of a thallus of *P. submarinum*. 12. SEM micrography showing a *P. submarinum* morphotype (iii) thallus formed by filaments with few ramifications and elongated cells. Cells present a rough cell wall. 13. *P. submarinum* both terminal and intercalar sporangia formed from vegetative cells. 14. Detail of intercalar sporangia. 15. *P. submarinum* sporangia showing a conical expulsion papilla (arrow). 16. Ovoid biflagellate swarmers. 17. Young, prostrate germlings of *P. submarinum* formed by a few cells. 18. Young germlings of *P. submarinum* with erect development. 19. Diploid metaphase with 12 chromosomes. 20. Schematic depiction of the diploid metaphase chromosomes of Figure 19. 21. Haploid metaphase with six chromosomes. 22. Schematic depiction of the haploid metaphase chromosomes of Figure 21.

Harris and Lewis, Co. Wexford, Co. Clare (Burrows 1991); in the Adriatic (Gallardo *et al.* 1993); Baltic Seas (Nielsen *et al.* 1995); in Greenland (Pedersen 1976); Faroes (Nielsen & Gunnarsson 2001); France (Gallardo *et al.* 1993); Iceland (Caram & Jónsson 1972); Italy (Gallardo *et al.* 1993); Netherlands (Stegenga & Mol 1983); Spain (Bárbara *et al.* 2005) and Sweden (Kylin 1949). From Atlantic Islands it was

registered in Salvage Islands (John *et al.* 2004). In the Southern hemisphere it was registered in Australia (Queensland) and New Zealand by Phillips (2002) and Lewis (1987) and in Argentina on *Hymenena falklandica*, in Santa Isabel by Gauna and Parodi (2008).

Our observations showed that *P. submarinum* thalli frequently infect extensive areas of fronds of *R. pseudopalmata*. It would be of great importance to have the complete register of the presence of *P. submarinum* in the coasts of Argentina to determine putative differences in behavior on different algal substrates. Cell dimensions, morphology and reproductive structures of the studied populations coincide in general with the description of the material observed by Wille (1901). We observed differences only in the dimensions of the swarmers, which were here smaller in both types, that is, quadriflagellate and biflagellate swarmers.

Pseudendoclonium submarinum from Argentina presented some morphological differences with respect to the individuals observed by Nielsen (1980) in Denmark. First, cell dimensions were larger in individuals of the populations of Argentina, and second, Nielsen (1980) reported this species growing also on rocks, immersed plants and on *Mytilus edulis* L. showing in this case also an epizoic habit (see also Nielsen & McLachlan 1986). Wille (1901), in turn, observed aplanospores and akinetes, structures not observed in this study.

There was strong karyological evidence that the species developmental cycle is diplo-haplo bionthic (e.g. alteration of sporophytes and gametophytes). Here, both bi- and quadri-flagellate swarmers came from different mother cells in the same thallus and they produced similar filaments upon germination. Nielsen (1980) also observed both quadriflagellate and biflagellated swarmers in the Denmark populations. Nielsen and we suggest the latter could be anisogametes. Nevertheless, here sexual reproduction could not be completely documented, since although swarmers can putatively act as gametes, neither fecundation nor development of zygotes was observed.

The level of ploidy of the present population ($1n = 6$; $2n = 12$) was also foreseeable, since according to Kapraun (1993) the Chaetophoraceae have chromosome complements of $1n = 4–8$ and $2n = 11–15$. Available information indicates also that members of this family typically have short, rod-shaped chromosomes 0.5–1.0 μm long.

This work showed that in nature, *P. submarinum* uses as a proper substrate *R. pseudopalmata*'s thalli, since it develops on them their entire life cycle, although epiphytism degree is not severe enough to cause losses in the hosts' capacities of reproduction and biomass formation. This revealed a nutritional independence between both algal species. The epiphytic habit offers ecological advantages for *P. submarinum* thalli, which have available substrate, light and nutrients. Under culture conditions, *P. submarinum* swarmers demonstrated a normal germination capacity on both organic and inorganic substrata, suggesting a low specificity for the colonization process, phenomenon also observed by Correa and McLachlan (1991) in *A. operculata* spores.

Several studies have been made about both prevalence and distribution of epiphytes on numerous seaweeds (Correa *et al.* 1987; Garbary *et al.* 1991; Correa & Sánchez 1996; Ellertsdóttir & Peters 1997). A frequency of infection of 80% was observed in fronds on *Chondrus crispus* Stackh (Correa *et al.* 1987). In epidemiological woks on *Mazzaella laminarioides* (Bory) Fredericq (Correa & Sánchez 1996) infections varying from 45% to more than 80% were observed. These frequencies of infection were higher than the frequency observed here in *R. pseudopalmata*. Besides, fronds of *R. pseudopalmata* showed infected mainly the basal region, whereas in *C. crispus*, is the mid-region of the frond the most commonly infected area, showing the apices a low level of infection, and being basal portions and discs never infected.

Recent works on algal red hosts from Argentine coasts were studies about *Gracilaria gracilis* (Martín *et al.* 2007), *R. pseudopalmata* and *Hymenena falklandica* (Gauna & Parodi 2008). The presence of *Laminariocolax aecidioides* on *Undaria pinnatifida* (Gauna *et al.* 2008) was reported recently.

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