FRESH WATER FUNGI OF NORTHERN TAIWAN

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Abstract: Fresh water pools, rivers and garden ponds of northern Taiwan were examined for representatives of the Saprolegniaceae and Blastocladiaceae. The predominant fresh water isolations included ***Achlya*** and ***Dictyuchus*** while less frequently found were the genera ***Allomyces*** and ***Saprolegnia.***

INTRODUCTION

The fresh water filamentous and highly branched fungi are world wide in distribution. Most representative species are saprophytic and grow on both vegetative and animal material. Some species are parasitic on aquatic life. Depending on species, parasitism occurs on plant roots, amphibia and their eggs, microscopic animals and fish (Sparrow, 1960). *Saprolegnia parasitica* is a species very destructive to the commercial industries of both ornamental and edible fish. Gills, fins and internal tissues are attacked by this species.

Saprolegniaceae is well documented in the literature. A thorough treatise was presented by Coker over 50 years ago (Coker, 1923) while the latest revised taxonomic presentation was quite recently published (Dick, 1973). A study by Sparrow is the standard reference for the Blastocladiaceae, including the *Allomyces* species (Sparrow, 1960). *Achlya* (Johnson, 1956), *Aphanomyces* (Scott, 1961) and *Saprolegnia* (Seymour, 1970) have received separate and detailed studies of the known species. Northern Taiwan has available many fresh water habitats yet it is an area suitable in size for a meaningful study on a specific group of fungi, similar to a study previously completed (Volz & Beneke, 1972).

MATERIALS AND METHODS

Northern Taiwan and the metropolitan areas of Taipei were visited for the collection of fresh water samples. Material was collected from pools, rivers and garden ponds. Specimens consisted of water from the collection sites in addition to submerged shore line soil, algae or leaf litter. A total of 120 collections were made. Each collection was placed in a small self sealing sterile plastic bag containing 40 to 60 ml of the fresh water sample.

Soon after the collections were made, the samples were brought to the laboratory and placed in sterile plastic Optilux petri plates. From 3 to 5 autoclaved hemp seed halves were floated on the petri dish samples with the cut side of the seed placed on the water meniscus. Pre-sterilized hemp seeds were individually cut through the short axis of the seed using a single edge razor blade. This cut produced the largest seed endosperm surface area suitable for zoospore contact,

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encystment and germination. Hyphal growth is supported by the seed endosperm and embryo. Aerobic zoospores are more abundant at or near the water surface, creating a high inoculum for the hemp seed halves. Mycelial growth with sporangia developed after 3 to 5 days incubation at room temperature. Within that time period or shortly thereafter some specimens produced oogonia and antheridia for species identification purposes. Mature colonies grown on hemp seeds were directly observed microscopically in the petri dishes for species identification. India ink illustrations were made directly from the microscope observations. Hyphal material containing structures for identification were occasionally observed from direct colony transfers using microscope slides and cover slips. Generic identification was made by sporangial development and zoospore emergence while species were identified by oogonia and antheridia when present. Specimen identifications were made from selected taxonomic keys (Coker, 1923; Dick, 1973; Dick, 1969; Johnson, 1956; Scott, 1961; Seymour, 1970; Sparrow, 1960).

RESULTS

The most commonly found genus isolated from the hemp seed baited samples was *Achlya*. Twenty-four isolations of *Achlya* sterile were obtained. The sterile cultures only produced the achlyoid zoosporangia (Fig. 5), however, variations were noted between cultures. Growth vigor, zoosporangia size and abundance, and variation in gemmae production and general shape were noted differences in the sterile *Achlya* isolations. Sterile strains of *Dictyuchus* were found in 9 water samples. We were not able to induce oogonia or antheridia in the *Dictyuchus* isolates, only the characteristic zoosporangia were produced in abundance in each culture (Fig. 1). Hyphal detached zoosporangia, cylindrical or branched sporangia, and sporangia with internal wall delimitations were found in *Dictyuchus* sterile strains. A total of six *Aphanomyces* isolates were also obtained from the 120 water samples studied. The *Aphanomyces* were also sterile strains with only zoosporangia present for genus identification (Fig. 7). One hemp seed culture produced only coenocytic hyphae without sporangial development.

Two isolations each of *Achlya flagellata* Coker (Fig. 2) and *A. prolifera* C. G. Nees (Fig. 4) were collected in separated areas of northern Taiwan along with one isolation of *A. crenulata* Ziegler (Fig. 3). Selected identifying characteristics within these three *Achlya* species are distinguishing taxonomic features. *Achlya flagellata* oogonia are generally oval in shape, smooth walled, pitted under the antheridium, and contain eccentric spherical oospores not filling the oogonium. The antheridia are monoclinous, diclinous or androgynous. The oogonia of *A. crenulata* are crenulate in shape and positioned on stout oogonial stalks. The oospores are commonly found one to 4 per oogonium. Antheridia are frequently lacking, sparse when present, diclinous or monoclinous in position. The most distinguishing characteristic of *A. prolifera* is the diclinous antheridial branches that are highly branched and commonly found tightly wrapped around the oogonia and at times around hyphal filaments or oogonial stalks.

One isolation of *Saprolegnia unispora* Coker et Couch, comb. nov. (*Isoachlya unispora* Coker et Couch) was obtained (Fig. 8). The saprolegnoid zoospore discharge of the sporangia directs the current taxonomic consideration of placing *Isoachlya* species within the genus *Saprolegnia* (Seymour, 1970). Oospores are found singly or at times two per oogonium, and antheridia are absent.

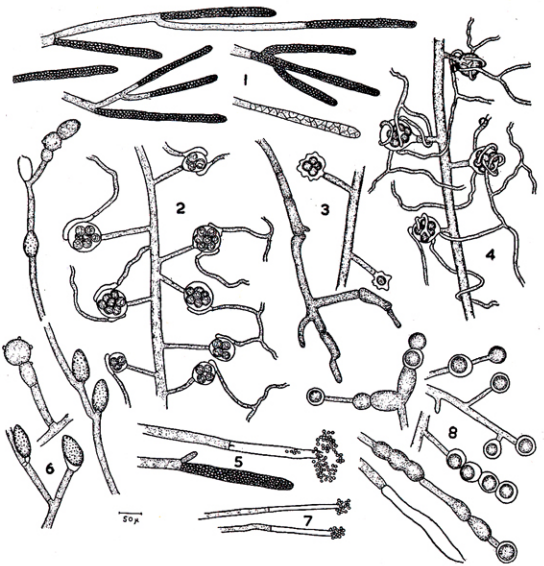

Fig. 1. Zoosporangia, one detached, one cell wall delimited and variations of mature zoosporangia of *Dictyuchus* sterile.
2. Oogonia with mature oospores and attached antheridia of *Achlya flagellata*.
3. Two oogonia and gemmae of *Achlya crenulata*.
4. Oogonia with oospores and antheridia of *Achlya prolifera*.
5. One mature zoosporangium containing zoospores and one empty zoosporangium with spores in the first encystment stage of *Achlya*.
6. *Allomyces neo-moniliformis* oogonia, antheridia, sporangia and resting spores.
7. Zoosporangia and encysted spores of *Aphanomyces* sterile.
8. *Saprolegnia "Isoachlya" unispera* oogonia and one empty zoosporangium.

A single isolation of *Allomyces neo-moniliformis* Indoh was found in the aquatic samples studied (Fig. 6). The species is subdichotomously branched, sporangia are terminal, cymose or catenulate with terminal sporangia clavate to somewhat cylindrical and the catenulate ones barrel shaped. Resting spores are terminal or cymose, oval to elongate, with scattered pits.

DISCUSSION

The current study confirms the presence of one fresh water filamentous fungus, *Achlya prolifera*, reported previously in Taiwan (Sawada, 1961). The 1961 list of fungi found in Taiwan also included *Dictyuchus monosporus*. We were able to isolate several strains of *Dictyuchus* in northern Taiwan but none of our isolates produced oogonia and antheridia for species determination. The sterile strains could be the same species isolated by Sawada but the genus now has the ability to produce only sporangia. The development of oogonia and antheridia could be influenced by temperature or other environmental changes. Our collections were made in May and June.

Several sterile *Achlya* isolations were also currently recovered. Further studies are planned to determine if the strains are heterothallic or can be induced to develop their complete life cycle. General observations were made of the *Achlya* gemmae, and variation was noted among the sterile strains. More than one species could be represented among the sterile strains. Some strains closely represented gemmae production of the heterothallic *Achlya bisexualis* but species determination can not be made by gemmae. Extended favorable environmental conditions will induce vigorous vegetative growth, sporangial development, and propagation without the necessity of the sexual life cycle segment in the Saprolegniales.

Species not previously identified in northern Taiwan include *Saprolegnia unispora*, *Achlya crenulata*, *Achlya flagellata* and *Allomyces neo-moniliformis*. The common fish parasite, *Saprolegnia parasitica*, was not isolated by the techniques employed in this study. Other species should be found with further studies, including those species of economic importance.

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