Aquatic Hyphomycetes of Kumaun Himalaya, India

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Abstract. — Five species of aquatic hyphomycetes viz., *Lemonniera aquatica* de Wildeman, *Lunulospora curvula* Ingold, *Tetracladium marchalianum* de Wildeman, *T. setigerum* (Grove) Ingold and *Triscelophorus monosporus* Ingold are being reported from India for the first time. This paper also deals with a report of a new bait for aquatic hyphomycetes.

Introduction

Taxonomic studies of aquatic hyphomycetes have been made in other countries by many investigators including Ingold (1942, 1958 & 1967) Tubaki (1958), Peterson (1962, 1963a, b), Scott and Umphlett (1963) and Nilsson (1964), but in India the knowledge concerning these fungi is almost nil.

In the present study, two stations, Sat-Tal lake and the fresh water stream Niglat, were selected for the study of aquatic hyphomycetes. These two stations are situated at a distance of 15 and 10 km. from Nainital respectively.

Materials and Methods

Samples of brown and skeletonized or decorticated (partially or completely) submerged leaves of *Quercus leucotrichophora* A. Cam. ex K. N. Bahadur, *Q. himalayana* K. N. Bahadur and needles of *Pinus roxburghii* Sarg. were collected and examined for the presence of different hyphomycetes. Pure cultures were made with the help of single conidium. All the cultures were maintained in Corn Meal Agar- and Malt extract Agar at room temperature (14—18° C). Several baits viz., hemp seeds, seeds of *Tagetus erecta* Linn., freshly dried leaves of Oak, *Salix*, and *Potamogeton pectinatus* Linn. and news paper pieces were used for the isolation of different species.

Species isolated

1. *Lemonniera aquatica* de Wildeman
   Ann. Soc. Belge Microsc., 18: 143. 1894.
   (Fig. II: 7—10)

Mycelium septate, sphorophores are 115 μ—260 μ long. Phialides are produced at the apex of the sporophore. Each phialide gives rise

to a spherical swelling at its apex from which four arms develop simultaneously. Each of the four arms are 25 μ—62.5 μ long and 5 μ—8 μ in diameter. On germination a slender germ tube is produced at the tip of each arm.

Isolated from Ram-Tal (one of the Sat-Tal lakes) and Niglat stream in January 1979 on *Quercus leucotrichophora* A. Cam. ex K. N. Bahadur, and *Q. himalayana* K. N. Bahadur leaf litter.

2. *Lunulospora curvula* Ingold
Trans. Brit. Mycol. Soc., 25: 404. 1942.
(Fig. II: 1—6)

Macelium septate, conidiophore simple or branched 60 μ—190 μ long. Conidium (aleuriosporae) produced at the tip of the sporophore on a short stalk 4 μ—10 μ long. A number of conidia may be produced from the tip of the sporophore in succession. The conidium is simple, unicellular, lunate or sigmoid, 47 μ—110 μ in length and 5 μ—8 μ in diameter in the middle part and tapering to 1 μ—3 μ at the end. The conidia are liberated by the rupture of the stalk cell.

Isolated from Ram-Tal and Niglat stream in January 1979 on *Quercus leucotrichophora* A. Cam. ex K. N. Bahadur and *Q. himalayana* K. N. Bahadur leaf litter.

3. *Tetracladium marchalianum* de Wildeman
Ann. Soc. Belge Microsc., 17: 35. 1893.
(Fig. I: 1—4)

Hyphae branched and septate. Conidia produced on the tip of the sporophore. A single sporophore may produce as many as 3 conidia. Each conidium develops four divergent arms 22 μ—37.5 μ long, and may become septate later on. Two subspherical knob like structures are also formed. One situated on the dorsal surface of the branch slightly away from the point of its insertion and another at the axil of four divergent arms. On germination, the tip of each arm of the conidium gives rise to a seperate slender germ tube. In a few cases germination was also observed from the knob like structures.

Isolated from Ram-Tal and Niglat stream im January 1979, on *Quercus leucotrichophora* A. Cam. ex K. N. Bahadur and *Q. himalayana* K. N. Bahadur leaf litter.

4. *T. setigerum* (Grove) Ingold
Trans Brit. Mycol. Soc., 25: 369. 1942.
(Fig. I: 5—14)

Mycelium branched and septate. The formation of conidia is similar to that of *T. marchalianum* with some minor differences. This species differs from *T. marchalianum* in having three finger like project-

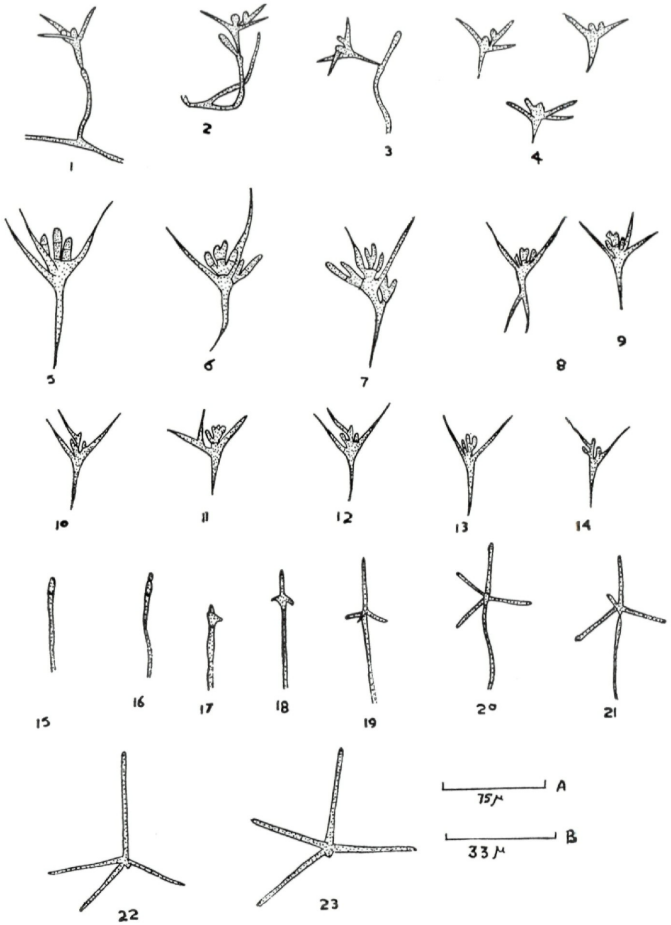

Fig. I: 1—4, scale A. *Tetracladium marchalianum* de WILDEMAN. — 1. Tip of the sporophore bearing a mature conidium. — 2. Tip of the sporophore bearing one mature conidium and a conidium primordium. — 3. Mature spore is being liberated leaving the spore primordium at the tip of the sporophore. — 4. Range of conidia

5—14, scale B; 5—7 and 8—14, scale A. *Tetracladium setigerum* (GROVE) INGOLD. — Range of conidia

15—23, scale A. *Triscelophorus monosporus* INGOLD. — 15. Swollen tip of the sporophore cut off by the septum to form the conidium. — 16. Septum dividing the conidium into basal and terminal cell. — 17. Formation of first lateral branch. — 18. Formation of second lateral branch and elongation of the terminal cell. — 19. Formation of third lateral branch. — 20. Mature conidium at the tip of the sporophore. — 21. Mature conidium prior to release. — 22 & 23. Two released mature conidia

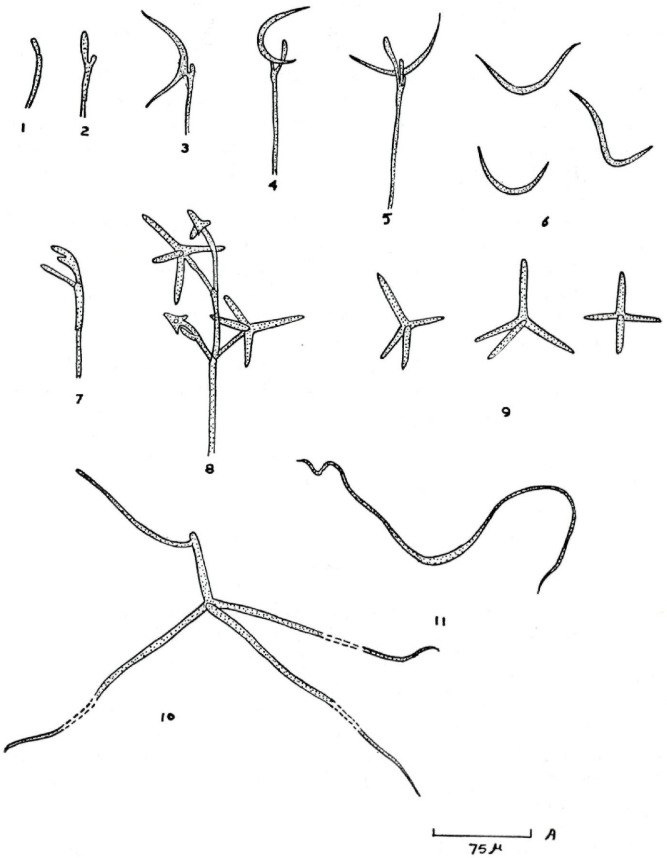

Fig. II: 1—6 & 11, scale A. *Lunulospora curvula* Ingold. — 1 & 2. Tip of the sporophore bearing conidium primordia. — 3. Sporophore bearing one conidium rested on the small stalk cell and a primordial conidium. — 4. Sporophore bearing one conidium and a clavate primordial conidium. — 5. Sporophore with two conidium primordia and one mature conidium. — 6. Released mature conidia. — 11. Germination of conidium

7—10, scale A. *Lemonniera aquatica* de Wildeman. — 7. Tip of the sporophore terminated into two phialides. — 8. Sporophore bearing conidia in different stages of development. — 9. Released mature conidia. —10. Germination of conidium

ions instead of two knob like structures. A mature divergent arm is 22 μ—50 μ mostly 30 μ—35 μ long and 2 μ—5 μ in diameter. Finger like projections measure 6.5 μ—18 μ in length and mostly 2.5 μ—4 μ and rarely 9 μ in diameter. Germination takes place by means of slender germ tubes arising from the knob like structures and rerely from the divergent arms. Besides normal conidia, our isolate produces 8 different types of conidia which constitute 80% of the total conidia. INGOLD (1942) also reported a few types of abnormal conidial production in his isolate.

Our isolate differs from those of INGOLD's (1942) and SCOTT & UMPHLETT's (1963) isolate in the mode of conidial germination. The conidia of our isolate germinate by slender germ tubes arising mostly from the finger like projections and rarely from the arms. While on the contrary, INGOLD (1942) and SCOTT & UMPHLETT (1963) observed the germination mostly from the arms.

Isolated from Ram-Tal and Niglat stream in January 1979 on *Quercus leucotrichophora* A. CAM. ex K. N. BAHADUR and *Q. himalayana* K. B. BAHADUR leaf litter.

5. *Triscelophorus monosporus* INGOLD
Trans. Brit. Mycol. Soc., 26: 152. 1943.
(Fig. I: 15—23)

Hyphae septate. Conidia produced directly on the sporophore unlike to that of *Lamonniera aquatica* which produces conidia on phialides. Main axis 87.5 μ—112 μ long and 3.9 μ—6.6 μ thick. The four divergent arms are developed in succession from the widest part of main axis. Each arm is 47—75 μ long and 3 μ—6 μ wide at the base and 0.6 μ—1.6 μ at the tip. Germination takes place by slender germ tubes arising from the arms.

Our isolate differs from those of SCOTT & UMPHLETT's (1963) and INGOLD's (1943) in the length of main axis and arms (fig. I). It was isolated from Ram-Tal and Niglat stream in January 1979 on *Quercus leucotrichophora* A. CAM. ex K. N. BAHADUR and Q. *himalayana* K. N. BAHADUR leaf litter.

Table 1. Showing different size of conidial axis and arms of *T. monosporus*, reported by previous workers

S.No.	SCOTT & UMPHLETT (1963)	INGOLD (1967)	Present species
1. Main axis	44 μ—55 μ × 3 μ—3.5 μ	50 μ—70 μ × 4 μ—5 μ	87.5 μ—112 μ × 3.9 μ—6.6 μ
2. Arms	26 μ—36 μ × 2 μ—3 μ	40 μ—50 μ × 2 μ—2.5 μ	47 μ—75 μ × 3 μ—6 μ at the base and 0.6 μ—1.6 μ at the tip.

In captivity all the above species were grown in water on the seeds of *Tagetus erecta* LINN.

Discussion

All species were reported during autumn to spring from both stations. In Sat-Tal lake, the hyphomycetes were isolated from the oak leaf litter present at the sluice. In case of Niglat stream, the species were isolated from submerged oak leaf litter. It was interesting to note that no species was present on *Pinus roxburghii* SARG. needles. It seems that the isolated species of aquatic hyphomycetes do not prefer *P. roxburghii* needles and it may be due to the presence of resinous substances in the needles.

Out of the six baits used during the present study the seeds of *Tagetus erecta* LINN. were found to be the best bait for aquatic hyphomycetes. The two interesting species viz., *Tetracladium marchalianum* and *Triscelophorus monosporus* were dominant on oak leaf litter under submerged condition. Out of the five aquatic hyphomycetes, two species viz., *Tetracladium marchalianum* and *T. setigerum* produce tetraradiate conidia attached to the sporophore by the tip of one of the four divergent arms; two species viz., *Lemonniera aquatica* and *Triscelophorus monosporus* also produce tetraradiate conidia that remain attached to the sporophore near the point of the emergence of the four arms; and one species viz., *Lunulospora curvula* produces unbranched lunoid or sigmoid conidia.

Acknowledgements

The work is supported financially by C. S. I. R. New Delhi. The authors are very much grateful to Prof. K. S. BHARGAVA, University of Gorakhpur for his kind initiation in this study. Thanks are also due to Prof. B. S. MEHROTRA, Head of the Botany Department, Kumaun University, Nainital for providing necessary laboratory facilities.

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