Studies on species of Conidiobolus from India-IV

By M. C. Srinivasan and M. J. Thirumalachar.
(Pimpri, Poona. India.)

With Plates XXIII—XXIV.

In the course of studies on *Conidiobolus* species from India, two undescribed species were isolated from decaying mushrooms during the rainy season. *C. utriculosus* Bref. the type of the genus was first described from isolates made from decaying fleshy fungi *Exidia* and *Hirneola* (Brefeld, 1884), and recently Dring (1958) reported *C. rhysosporus* Drechsl. from apothecia of *Ascobolus* species in England. In the present paper an account of these two new *Conidiobolus* species characterised by the formation of both microconidia and zygospores, is given. The type cultures of the new species have been deposited at the Culture Collections of Indian Agriculture Research Institute, New Delhi, C. M. I., Kew, England, A. T. C. C., Washington D. C. and Centraalbureau voor Schimmelcultures, Baarn, Holland.

Conidiobolus mycophilus. Srinivasan and Thirum. Sp. nov.

Mycelium thin-walled with hyaline or granular contents, branched, 6—8 μ wide, septate and becoming disjointed into hyphal segments; Conidiophores unbranched, phototrophic, undifferentiated from the vegetative hyphae, extending 30 to 50 μ and developing globose conidia at the apex. Primary conidia globose with dense contents, 20 to 26 μ in diameter and 25 to 30 μ in total length inclusive of a conical or obtuse basal papilla, 3 to 6 μ high and 6 to 8 μ wide; Conidia forcibly discharged at maturity, germinating directly or giving rise to secondary globose conidia of smaller size; Microconidia formed on radial sterigmata, commonly 8 to 20 per conidium, globose or pear-shaped with a tiny basal papilla, 6 to 9 μ in diameter and often showing repetitional development. Zygospores formed in older cultures through conjugation of hyphal segments, globose or sub-globose, 20 to 35 μ in diameter with a smooth wall 0,8 to 1,5 μ in thickness.

Habitat: Isolated from decaying mushroom, Poona. July 14th. 1963.

Mycelii hyphae tenuiter tunicatae, plasmate granuloso farctae, ramosae, 6—8 μ latae, septatae, postea in cellulas secedentes; conidiophoris simplicibus nec ramosis, in lucem protendentibus, ab hyphis vegetativis non diversis, 30—50 μ longis, conidia in apice gignentibus; conidia primaria globosa, 20—26 μ diam., in toto 25—30 μ longa, basi papilla 3—6 μ longa, 6—8 μ lata praedita, in maturitate violenter absilientia, statim germinantia vel conidia secundaria, globosa

minora emittentia; microconidia ex uno conidio plerumque 8—20 in sterigmatibus radiantibus orta, globosa vel piriformia, 6—9 μ diam., basi papilla minutissima praedita, saepe iterum iterumque orta; zygosporae e copulatione cellularum hypharum disjunctarum ortae, globosae vel subglobosae, 20—35 μ diam., leves, pariete 0,8—1,5 μ crasso praeditae.

The fungus makes rapid growth forming abundant conidia and zygospores on yeast glucose agar medium. The colony appears flat without appreciable development of aerial mycelium and in the early stages appears white due to the large number of phototrophic conidiophores developing conidia. The young growing hyphae are thin walled, branched and nonseptate with granular cytoplasm. (Fig. 1). Following septation, hyphal segments are delimited which are commonly 6 to 8 μ in diameter and which appear somewhat irregular due to the formation of lateral branches (Figs. 2, 3, 4). The conidiophores formed abundantly in young cultures, 2 to 3 days old are phototrophic laterals of the vegetative mycelium and are morphologically not distinguished (micronemous). They are unbranched, extending commonly 30 to 50 μ before developing the primary conidia at the apex (Figs. 5 & 6). Mature conidia are delimited by a well defined septum from the conidiophore and are forcibly discharged. Primary conidia are pear shaped due to the well defined conical or obtuse basal papilla, and are commonly 20 to 26 μ in diameter while the papilla measure 3 to 6 μ in height and 6 to 8 μ in width. (Figs. 7, 8, 9). Discharged conidia germinate directly by germ tubes which develop and form the vegetative mycelium or the conidia may resort to repetitional development. Secondary globose conidia of smaller dimensions are borne on secondary conidiophores which are simple and unbranched (Fig. 10), or branched with dilation and forking at the tip (Fig. 14) or branched almost upto the base (Fig. 13) and bearing two conidia simultaneously. In other cases two elongate secondary conidiophores arise independently from the same conidium and extend upto 100 μ before developing the secondary conidia (Fig. 12). The other extreme condition has also been observed where the secondary conidiophore is highly suppressed and the two secondary conidia appear to develop alsmost directly from the primary conidium (Fig. 11). The secondary conidia are morphologically similar to the primary ones (Figs. 15, 16, 17) and secondary conidia which are morphologically different have not been observed. Several conidia show the simultaneous development of microconidia on radial sterigmata. (Figs. 18, 19). These are subglobose, 6—9 μ in diameter (Figs. 20, 21) and germinate by a thin germ tube arising from the apical end (Fig. 22) or give rise to one or two secondary microconidia on short extensions of the primary microconidium (Figs. 23, 24, 25). In cultures 4—5 days old, zygospore formation is initiated and takes place through

conjugation between hyphal segments (Fig. 26). The young zygospores appear globose with dense granular contents (Fig. 27), while the mature ones are globose, subglobose, ovoid or somewhat angular in shape, (Figs. 28—34), commonly 20 to 35 μ in diameter surrounded by a smooth wall 0,8 to 1,5 μ in thickness and enclosing a cytoplasm containing one or two large excentric globules. Older cultures in which zygospore development has been completed appear flat with a folded surface.

Conidiobolus mycophagus Srinivasan & Thirum. Sp. nov.

Mycelium thin-walled with hyaline or granular contents, branched, 10 to 15 μ in diameter, becoming later separated into hyphal segments; Conidiophores micronemous, phototrophic, unbranched, 80 to 150 μ long, developing globose conidia terminally. Primary conidia 25 to 33 μ in diameter and 35 to 40 μ in total length inclusive of a large praboloid basal papilla 5 to 10 μ high and 10 to 14 μ wide, germinating directly or giving rise to secondary globose conidia or microconidia. Microconidia developed simultaneously on 10 to 15 radial sterigmata, globose or pyriform, 10 to 12 μ wide and 14 to 18 μ long; zygospores globose or subglobose, smooth, 30 to 36 μ in diameter with wall 0,5 to 1,5 μ thick.

Mycelii hyphae tenuiter tunicatae, plasmate granuloso praeditae, ramosae, 10—15 μ latae, septatae, postea in cellulas discedentes; conidiophoris simplicibus, nec ramosis, in lucem protendentibus, 50—150 μ longis, conidia globosa in apice gignentibus; conidia primaria globosa, 25—33 μ diam., in toto 35—40 μ longa, basi papilla paraboloidea, 5—10 μ longa, 10—14 μ lata praedita, in maturitate statim germinantia vel conidia secundaria et microconidia emittentia; microconidia ex uno conidio 10—15 in sterigmatibus radiantibus orta, globosa vel piriformia, 14—18 μ longa, 10—12 μ lata; zygosporae globosae vel subglobosae, laeves, 30—36 μ diam., pariete 0,5—1,5 μ crasso praeditae.

Habitat: Isolated from a decomposing mushroom, Poona. July 20th, 1963.

The fungus under study is readily distinguished from the first one by the larger dimensions of the mycelium, conidia and microconidia. The colony on yeast glucose agar appears flat, dull brown and powdery on account of the extensive formation of conidia. Older cultures are deeply wrinkled and often turn darker following the maturation of zygospores. The hyphal segments delimited from the assimilative hyphae are branched (Figs. 35, 36) and show granular cytoplasm enclosing tiny vacuoles. The conidiophores extend to a considerable height viz. 80 to 150 μ. before developing the conidia.

The conidiophores however show no morphological differentiation from the assimilative hyphae and are strictly micronemous (Figs. 37,

Comparative Statement of *Conidiobolus* species forming microconidia.

Species	Mycelium	Conidia	Microconidia	Resting spores	Special features
Conidiobolus polytocus	2—9 μ	12—25×14—29 μ	2 to 15 7—15× 6—11 μ	—	—
C. chlamydosporus	2—20 μ (Ca. 6—12 μ)	15—45×18—50 μ	2 to 20 8—11×10—16 μ	Chlamydospores 15—35× 8—29 μ	
C. megalotocus	1—5—15 μ (Ca. 4—12 μ)	10—42×12—44 μ	2 to 9 9—17×13—23 μ	—	—
C. gonimodes	5—8 μ (rarely upto 13 μ)	11—33×12—19 μ	2 to 15 8—16×5,5—11 μ repetitional development to yield smaller ones upto 5 μ	Zygospores 15—30×11—25 μ smooth	Formation of secondary microconidia often with adhesive tips
C. mycophilus	6—8 μ	20—26×25—30 μ	8 to 20 6—9 μ often showing repetitional development	Zygospores 20—35 μ smooth	
C. mycophagus	10—15 μ	25—33×35—40 μ	10 to 15 10—12×14—18 μ	Zygospores 30—35 μ smooth	
C. coronatus	6—15 μ	12—46 μ (G. W. Martin)	3—20 10—14×12—21 μ	—	Formation of villous spores that represent imperfectly developed microconidial sterigmata

Grateful thanks are due to Professor Dr. Franz Petrak for giving the Latin diagnosis of the new species described in this paper.

38). Primary conidia are globose subtended by a well developed paraboloid papilla. (Figs. 39, 40, 41). Secondary globose conidia are formed on short lateral extensions of the primary conidia and appear smaller in size (Figs. 42, 43, 44). Microconidia are developed by the globose conidia on radial sterigmata and usually number 10 to 15 per conidium (Figs. 45,46). The microconidia are 10 to 12 μ side and 14 to 18 μ in length (Figs. 47, 48).

Zygospores are formed abundantly through conjugation between hyphal segments belonging to the same mycelium (Fig. 50) or different hyphae (Figs. 49, 51). Mature zygospores are smooth walled, 30 to 36 μ in diameter, globose or subglobose with a wall 0,5 to 1,5 μ in thickness, enclosing a granular cytoplasm and excentric globule (Figs. 52, 53).

Discussion.

The two fungi under study have to be compared with species in which formation of microconidia have been reported. Drechsler has reported microconidia in *C. polytocus*, *C. chlamydosporus* (Drechsler, 1955) and *C. megalotocus* (Drechsler, 1956). These are however different due to the absence of formation of zygospores. Drechsler (1961) described *C. gonimodes* as a new species forming microconidia and zygospores. The species under study are distinct from it in their spore measurements as well as in the lack of secondary microconidia with adhesive tips. The well known species forming microconidia referred to as *Entomophthora coronata* (Cost) Kevor. has been recently shown to be a species of *Conidiobolus* and a new combination. *C. coronatus* (Cost) has been proposed. (Srinivasan and Thirumalachar 1964). A comparative account of species of *Conidiobolus* forming microconidia has been presented in Table I.

Writers thanks due to Dr. F. Petrak for rendering Latin diagnoses.

References.

Brefeld, O., 1884: *Conidiobolus utriculosus* und *minor*. Untersuch. Gesammt. Mykol., 6, 35—72.

Drechsler, C., 1955: Two new species of *Conidiobolus* that produce microconidia. Amer. J. Bot. 42. 793—801.

— 1956: Two new species of *Conidiobolus*. Amer. J. Bot., 43, 778—786.

— 1961: Two species of *Conidiobolus* often forming zygospores adjacent to antheridium-like distentions. Mycologia, 53, 278—303.

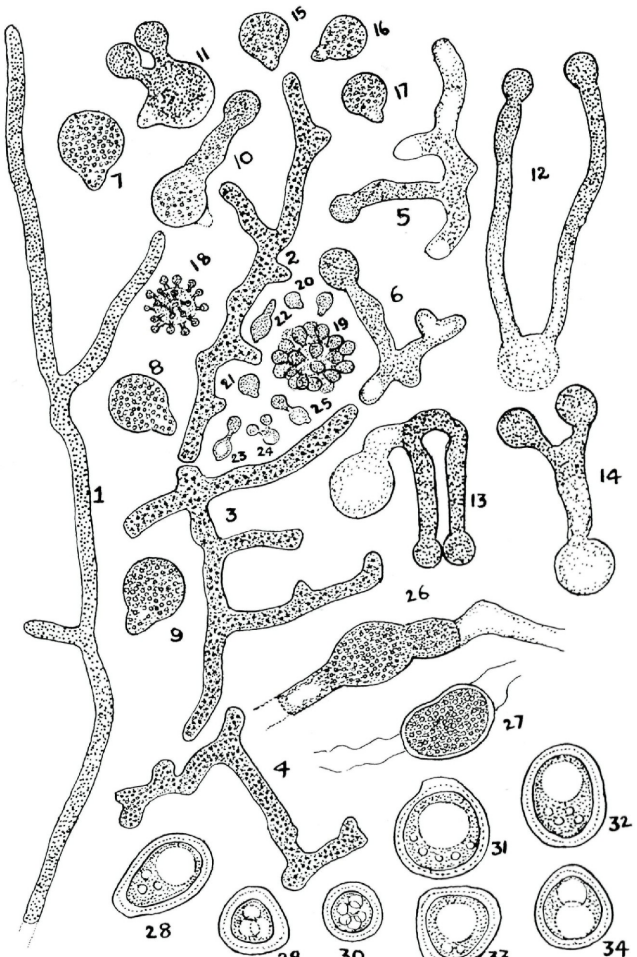
Dring, V. J., 1958: *Conidiobolus rhysosporus* Drechsler in Great Britain. Trans. Brit. Mycol. Soc., 41, 52—54.

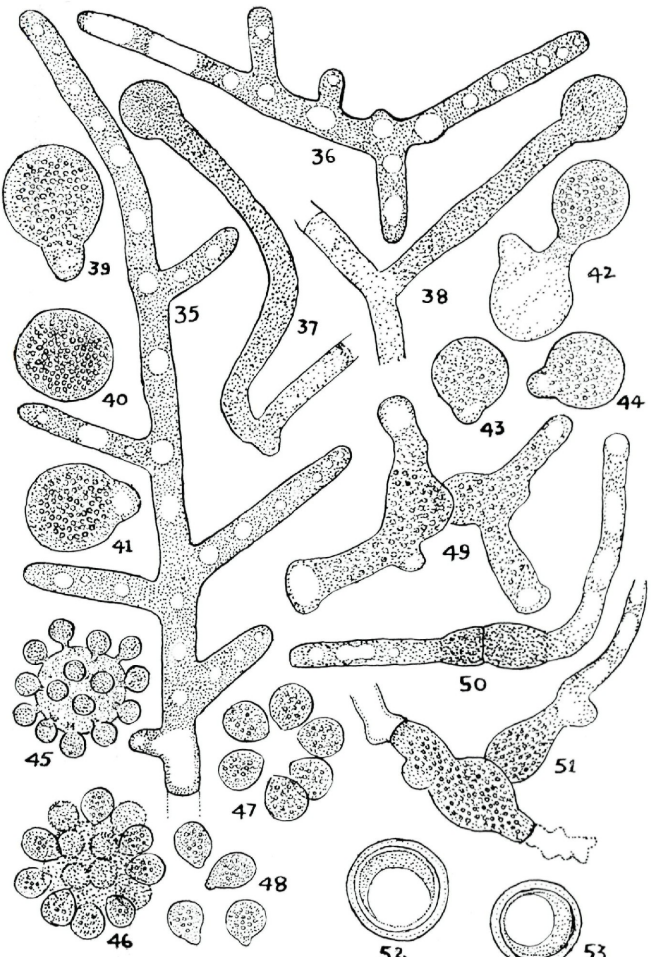
Srinivasan, M. C. & M. J. Thirumalachar, 1964: On the identity of *Entomophthora coronata*. Mycopath. Mycol. Appl. 25, 1—3.

Plate XXIII.

Figs. 1—34. *Conidiobolus mycophilus* (× 500).

1: Young mycelium. — 2—4: Hyphal segments. — 5, 6: Conidiophores with developing conidium. — 7—9: Primary conidia. — 10—14: Formation of





secondary conidia. — 15—17: Secondary conidia. — 18, 19: Formation of microconidia. — 20, 21: Microconidia. — 22: Germination of microconidium. — 23—25: Formation of secondary microconidia. — 26: Conjugation of hyphal segments. — 27: Young zygospore. — 28—34: Nature zygospores.

Plate XXIV.

Figs. 35—53: *Conidiobolus mycophagus* (× 500).

35, 36: Hyphal segments. — 37, 38: Conidiophore with developing conidium. — 39—41: Primary conidia. — 42: Formation of secondary conidium. — 43, 44: Secondary conidia. — 45, 46: Formation of microconidia. — 47, 48: Microconidia. — 49—51: Conjugation of hyphal segments. — 52, 53: Mature zygospores.