

CONIDIUM ONTOGENY IN HYPHOMYCETES.
ARTHRIINIUM PHAEOSPERMUM (CORDA) M.B. ELLIS AND *DICTYO-*
ARTHRIINIUM SACCHARI (STEVESNON) DAMON

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Abstract

The conidiogenous cells and conidium ontogeny in *Arthriniium phaeospermum* (Corda) M.B. Ellis and *Dictyoarthrinium sacchari* (Stevenson) Damon are analysed and illustrated by time-lapse photomicrography and from fixed material. Successive conidia are shown to be produced by lateral extensions in the apical region of the distal conidiogenous cell of the former and by the production of successive, but not strictly basipetal, growing points on the basauxic conidiophore of the later.

Introduction

At present, although extensive accounts of ontogenic patterns of conidiogenesis in the hyphomycetes have been published, we have no detailed information available on conidiogenesis in fungi possessing what Hughes (1953) termed 'basauxic' conidiophores. This type of conidium ontogeny was first described in the genera *Papularia* Fr., *Arthriniium* Kunze ex Fr., *Endocalyx* Berk., *Dictyoarthrinium* Hughes, *Spegazzinia* Sacc., and in *Graphiola* Poit., a genus that has been classified in the Ustilaginales. The conidiophores were said to sometimes arise from barrel or flask-shaped mother cells. This was considered to be the case in *Papularia*, *Arthriniium*, *Dictyoarthrinium* and *Spegazzinia*. *Dictyoarthrinium sacchari* (as *D. quadratum* Hughes) was said to have conidiophores which elongate by a growing point either within or just above the conidiophore mother cell. Ellis (1971) noted the presence of basauxic conidiophores in the genera *Arthriniium*, *Cordella* Speg., *Pleuroconium* Sacc. ex Grove and *Spegazzinia*.

A lack of detailed observational data on conidiogenesis in this group was severely felt at the Kananaskis conference on criteria and terminology in the classification of Fungi Imperfecti. Tubaki (1971) pointed out at the time that the basauxic phenomenon has usually been inferred rather than observed. The concept of the basauxic phenomenon remained to be unequivocally confirmed.

An obvious source of the needed data is time-lapse photo-micrographic studies. In this paper an analysis of conidium ontogeny in two hyphomycetes thought to exhibit the basauxic phenomenon is presented.

Materials and Methods

The culture of *Arthriniium phaeospermum* (IMI 103014) used in this study was obtained from the Commonwealth Mycological Institute and that of *Dictyoarthrinium sacchari* from the culture collection of the Eidgenossische Technische Hochschule, Zurich (ETH 470, CBS 529.73). The cultures were maintained on 2% malt agar. The procedures and techniques followed were as described by Cole *et. al.*, (1969).

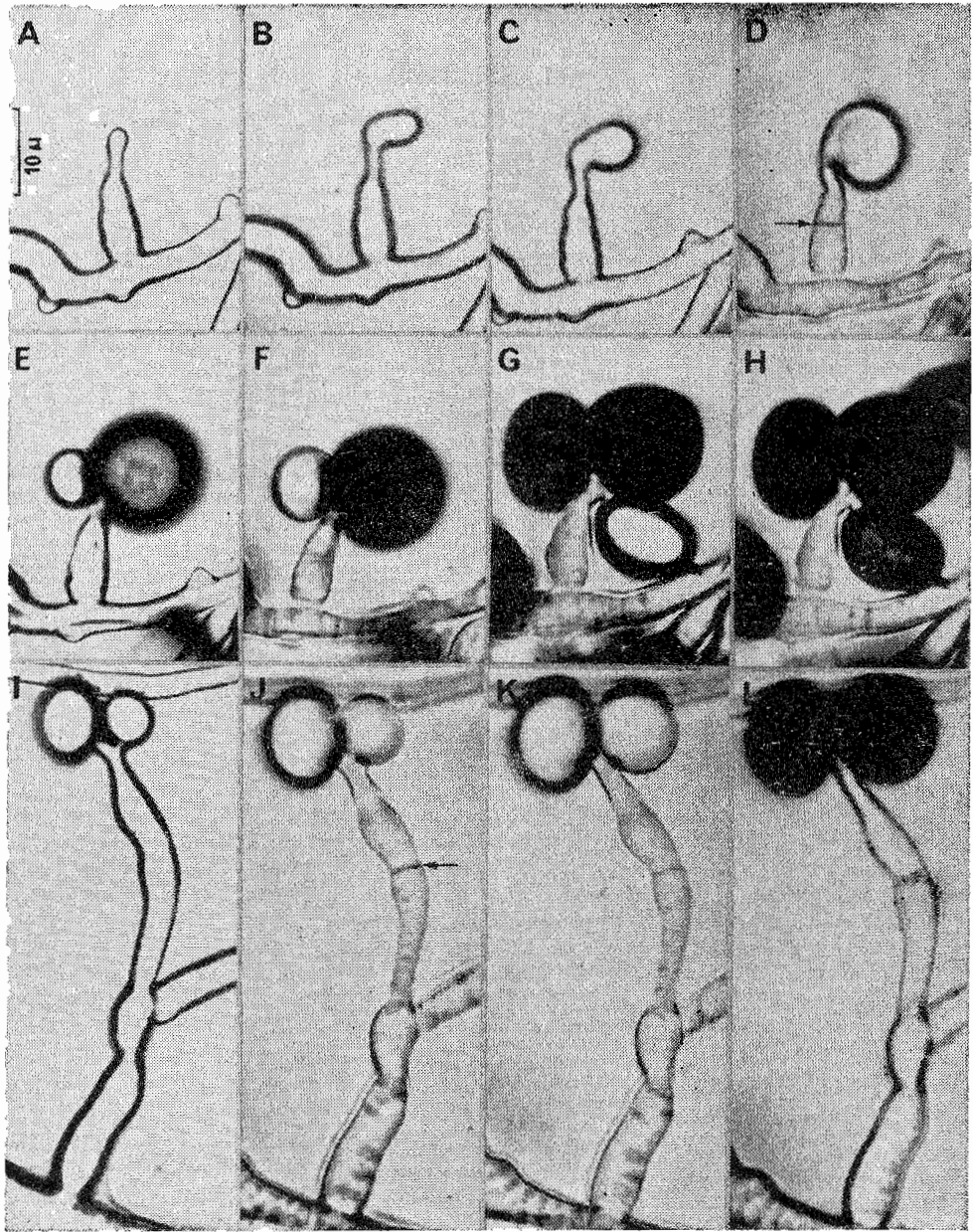


Fig. 1. Time-lapse sequence of conidiogenesis in *Arthrinium phaeospermum*.

TIME-LAPSE OBSERVATION OF CONIDIUM ONTOGENY IN
ARTHRIUM PHAEOSPERMUM

Figure 1A shows a short, swollen, one-celled conidiogenous hypha with a narrow distal tubular extension at the apex. After a period of 30 minutes (Fig. 1B) the apex has swollen considerably. During the next three hours (Figs. 1C and 1D) this swells further and assumes a globose shape. At this stage a septum appears in the middle of the conidiogenous cell (arrow in Fig. 1D) delimiting the area of meristematic activity from the bulbous basal region. During the next 18 hours (Fig. 1E) this vesicle grows further, becomes pigmented, is delimited by a septum and differentiates into the primary conidium. At this time also a second growing point, located below and to one side of the first formed terminal conidium, becomes evident and a recognisable conidium initial comes into being. This enlarges and becomes pigmented during the next eight hours (Fig. 1F) and the primary conidium matures further. A third growing point giving rise to a swelling becomes the third conidium and comes into existence during the next 13 hours (Fig. 1G). This originates on the opposite side to the point of origin of the second conidium initial. The third conidium attains maturity in the next six hours (Fig. 1H) after which no further growth occurred, probably due to exigencies of our culture conditions, particularly a depleted oxygen supply. At this stage a pattern similar to that of a sympodular mode of development is apparent. It differs from the normal sympodial pattern, however, in that the third conidium originates at a point immediately below the first conidium rather than below the second.

Figures 1I—1L show another sequence of conidium formation and maturation. The second conidium is formed at the tip of a short lateral proliferation of the conidiogenous hypha. In Fig. 1I apical and subapical conidial initials have been formed. After the first 90 minutes (Fig. 1J) a septum appears in the middle of the conidiogenous hypha (indicated by an arrow). During the next two hours (Fig. 1K) these two conidia show additional growth and attain full maturity after a further eight hours. The apex of the conidiogenous cell in Fig. 1L shows a small, but recognisable, increase in length during this process.

TIME-LAPSE SEQUENCE OF CONIDIUM ONTOGENY OF
DICTYOARTHRIUM SACCHARI

Conidiogenesis in *D. sacchari* is illustrated in Fig. 2. Figure 2A shows a developing conidium initial delimited by a septum (arrow) at the apex of a short conidiogenous hypha. The conidiogenous hypha is not as distinct in this species as in *A. phaeospermum*, being integrated with the main hypha and no differentiated conidiophore mother cell is distinguishable. During the first 12 hours of development (Fig. 2A) this conidium initial enlarges and becomes a subspherical, dark-coloured, cruciately septate conidium. The conidiogenous hypha shows a concomitant increase in length and is delimited from the main hypha by a broad septum (lower arrow in Fig. 2B). The next 20 hours (Fig. 2C and 2D) show further enlargement of the conidium and a substantial increase in length of the conidiogenous hypha. During this time an additional septum appears above the first one (arrow head in Fig. 2D). In the next 8 hours (Fig. 2E) the conidium becomes fully mature while the conidiogenous hypha shows an appreciable increase in length in the basal region. By comparing the distance between the lower arrow head in Figs. 2D and 2E we can confirm that the conidiogenous hypha shows intercalary meristematic growth during conidium formation. Further growth of the conidiogenous cell could not be recorded, probably due to a reduced oxygen supply and other inhibitive conditions of the plate culture technique.

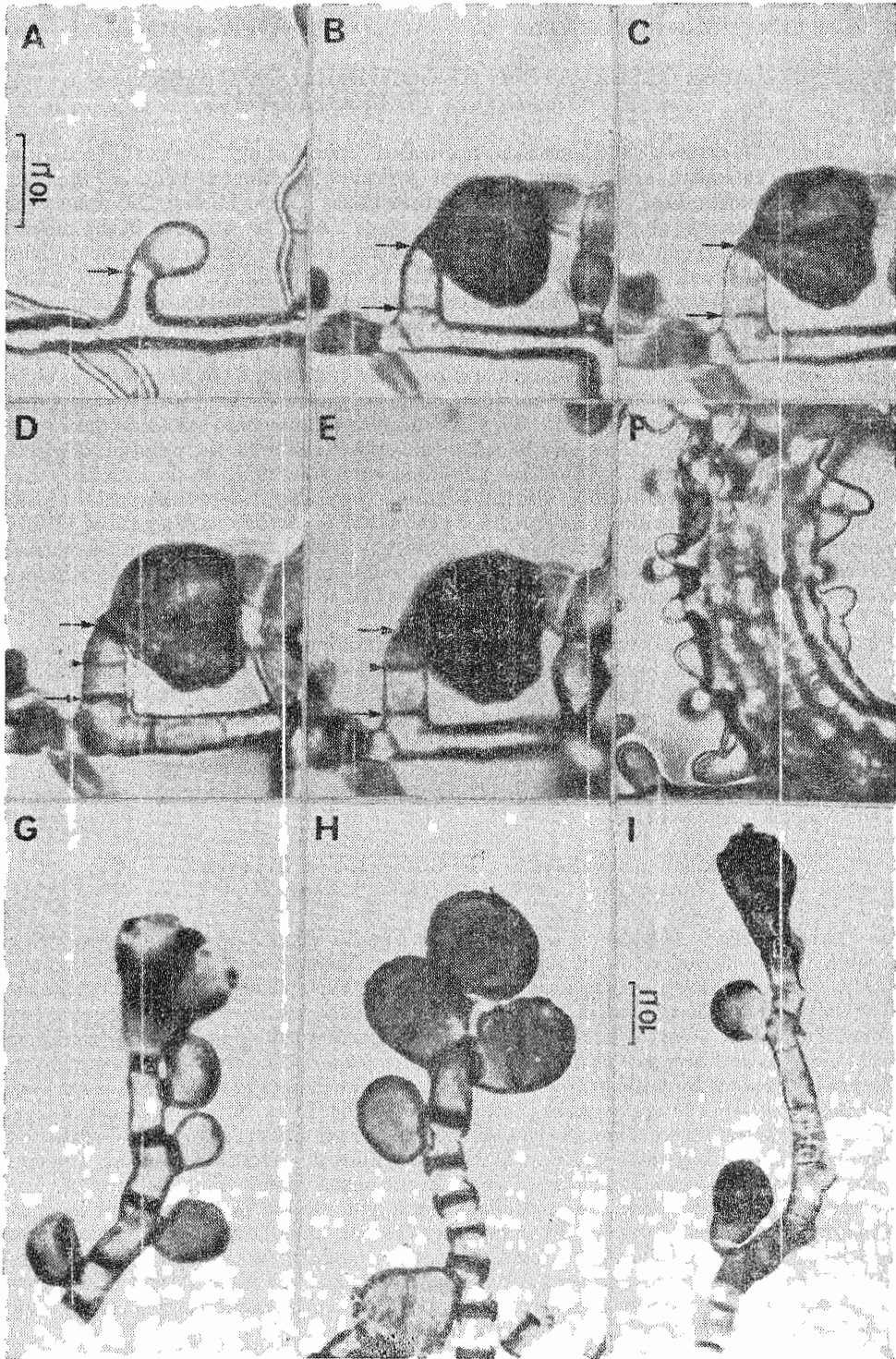


Fig. 2. Time-lapse sequence of conidiogenesis in *Dictyoalthrinium sacchari*.

Initiation of conidiogenous hyphal formation is signaled by the appearance of numerous lateral swellings arising at localized areas of the fungal mycelium where hyphae tend to form compact mycelial ropes (Fig. 2F). These swellings later develop into conidiogenous hyphae. Due to the conditions of growth provided by our plate culture procedure most of these fail to develop and produce any conidia. However, under more normal conditions, the fungus produces long, cylindrical, pale brown conidiogenous hyphae with highly refractive, thick transverse septa (Figs. 2G-2I). These hyphae produce a number of conidia which arise as lateral swellings. The conidia do not always arise in strict basipetal succession.

Discussion

The time-lapse sequences of conidium ontogeny in *Arthrinium phaeospermum* obtained during this study show the fungus to produce successively active conidiogenous loci at the apex of each conidiogenous cell. A very small concomitant increase in length of the conidiogenous cells occurs as the terminal and subterminal conidia are formed. Hughes (1971) in discussing the definition of a 'sympodula' expressed the opinion that the elongation or swelling of the cell should be considered of secondary importance to the production of successive new growing points. The pattern exhibited by *A. phaeospermum*, at least in the production of the first three conidia, fits perfectly the definition of 'sympodial' proliferation offered by Kendrick (1971). This is not to say, however, that further conidia are not formed further back on the conidiogenous cell under conditions which was unable to provide in my culture chambers. No meristematic activity was detected after the initiation of conidiation except in the apical region. This contrasts significantly with my observational data on *Dictyoarthrinium sacchari*.

In *D. sacchari* the conidiogenous hypha increases in length by intercalary growth immediately after the differentiation of the first conidium. This diffuse meristematic region does not however, as suggested by Hughes (1953), appear to be located within or just above a distinct conidiophore mother cell. In fact at this stage it is difficult to distinguish any conidiophore mother cell. Following the formation of the first conidium successive conidia are formed laterally on the extending conidiogenous hypha though not in a regular basipetal sequence. Apart from the absence of a strictly basal meristem this pattern essentially reflects Hughes' original concept of a 'basauxic' conidiophore.

The ontogenic patterns encompassed within the 'basauxic' type as at present accepted are clearly variable. This study shows that the two fungi currently described as possessing 'basauxic' conidiophores have very different patterns of development. In *A. phaeospermum* the meristem remains at the apex of the conidiogenous cell for sometime whereas in *D. sacchari* the meristem or conidiogenous locus moves downwards after the first conidium is formed. Further studies designed to fully document the manifestations of conidiogenesis in related fungi are in progress.

References

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