

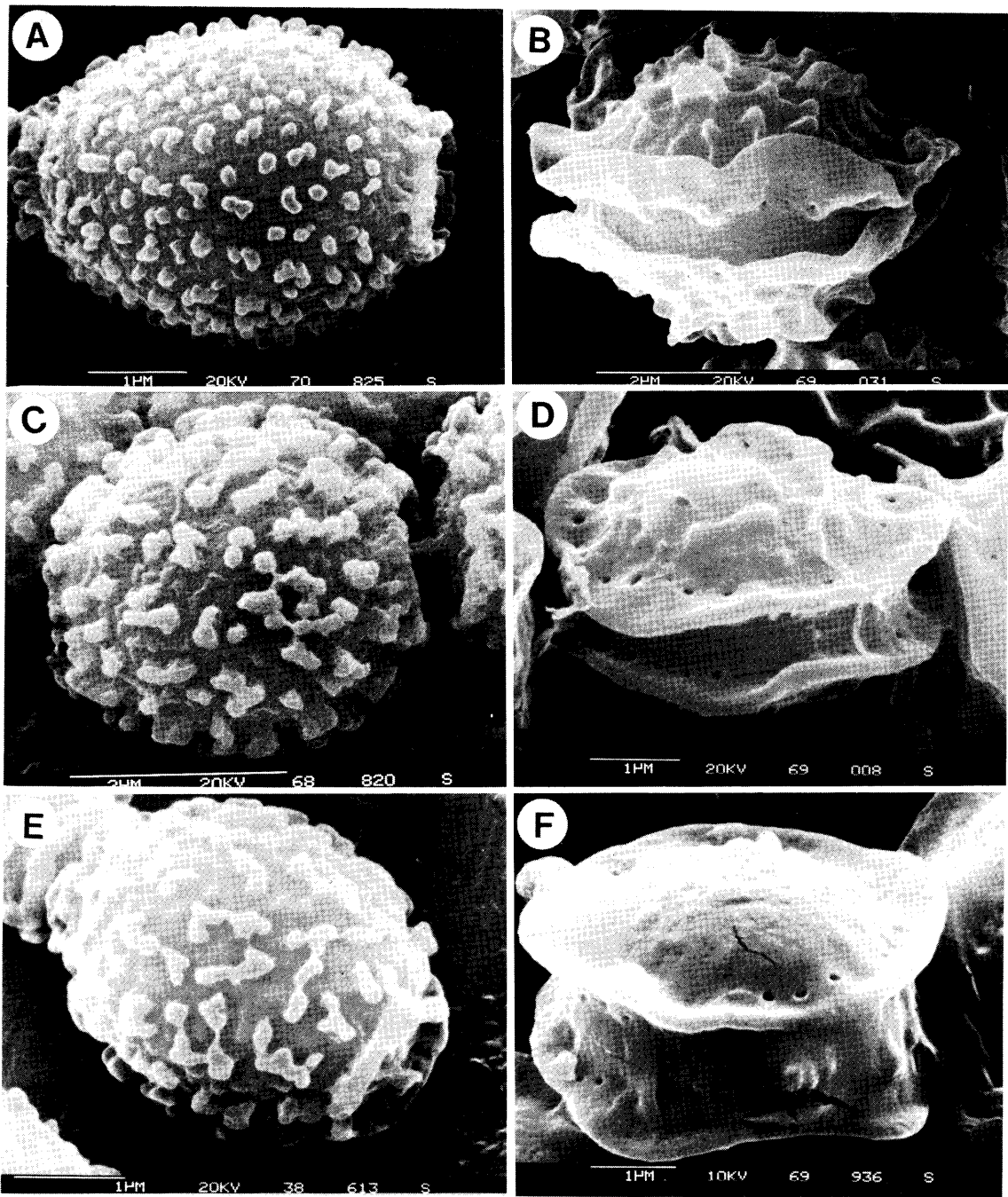


Fig. 38. *A. glaucus* group: SEM micrographs of anamorphic and teleomorphic spores of A,B, *E. cristatum*, IMI 172280; C,D, *E. spiculosum*, IMI 278376; E,F, *E. chevalieri*, IMI 211382.

Description: *Conidia* lobate-reticulate. *Conidiogenous cells* uniseriate. *Conidiophores* small, 300 μm long. *Conidial heads* can be brown or white. *Ascomata* bright yellow. *Ascospores* with equatorial crests thickened, moderately pronounced, hemispheres bearing lobate-reticulate echines.

Caten crossed these white and brown isolates (termed A1 and A2) and found the F1 recombinants segregated out at a ratio of 2 white:1 brown:1 green. He submitted cultures from the green F1 genotype to UV light and, as a result, further selected white and brown mutants termed A9/1 and A9/2 respectively. He also produced white and brown mutants by exposing *A. vitis* (*E. amstelodami*) to UV light. He concluded that white and brown mutants of *E. heterocaryoticum* are naturally-occurring mutants of a green ancestor.

Again, by using traditional means of identification, he concluded that the A9 isolate (the F1 recombinant of *E. heterocaryoticum*) was a culture of *E. amstelodami*. He argued that if *E. amstelodami* was the ancestor of *E. heterocaryoticum* then it should be possible to simulate the evolution of *E. heterocaryoticum* in the laboratory by inducing development of white and brown conidial colour mutants. This he succeeded in doing. Finally, he crossed the brown strain A2 of *E. heterocaryoticum* with a strain of *E. amstelodami*. They hybridized readily and produced white, brown and green F1 in the ratio 2:1:1. Random selection of progeny when cultured showed more variability in growth factors than previous crosses but otherwise were considered normal.

An evaluation of this series of crosses has been made using SEM to examine the relevant isolates. The results are as follows.

- (i) Conidia of the 'type' of *E. heterocaryoticum* and of the *E. amstelodami* isolate used in its description are quite different. Compare Fig.40, top series.
- (ii) Caten's A2 (brown) '*heterocaryoticum*' parent appears very close to the 'type' of *E. heterocaryoticum* (cf. Fig.40, left series), but the white A1 '*heterocaryoticum*' parent seems somewhat intermediate between *E. heterocaryoticum* and *E. amstelodami*. Compare Fig.40 bottom right with top series.
- (iii) The green recombinants selected from the F1 of cross A1 $\times$ A2 and designated A9 appears even closer to but not quite identifiable with *E. amstelodami*, cf. Fig.41 top left with Fig.40 top right.
- (iv) Conidia of the white and brown mutants derived from A9 by exposure to UV light are much closer to the 'type' of *E. heterocaryoticum*, and parent A1 (white), than they are to A9, cf. Fig.41 left series with Fig.40 top left and bottom right.
- (v) In marked contrast, the conidia of the white and brown mutants derived from the *E. amstelodami* isolate are identifiable with their parent's form, cf. Fig.41, right series. This follows the pattern of mutants of other species studied here.

It is concluded that until white and brown mutants have been obtained from the 'type isolate' of *E. heterocaryoticum* and used for the basis of such experimentation, the relationships between *E. heterocaryoticum* and *E. amstelodami* remain uncertain. The problem is made even more difficult by the fact that Christensen *et al.* designated a holotype (NFC C-100) which is white, and at the same time, a paratype (NFC 1C-104) which is brown.

Eurotium tonophilum Ohtsuki, *Bot. Mag. (Tokyo)* **75**: 438 (1962).

Aspergillus glaucus var. *tonophilus* Ohtsuki, Suda & Sai, *Misc. Rept Res. Inst. Nat. Resources, Tokyo* **17/18**: 76 (1950), *nom. nud.*

Anamorph: **Aspergillus tonophilus** Ohtsuki, *Bot. Mag. (Tokyo)* **75**: 438 (1962).

Illustration: Fig.37b.

Description: Conidia tuberculate. Conidiogenous cells uniseriate. Conidial heads few, grey-green. Conidiophores smooth, 120–145 μ m long. Ascomata embedded in lemon yellow hyphae. Ascospores not available.

Type: **Japan:** Tokyo, ex binocular lens, World War II, *T. Ohtsuki* (IMI 108299, holotype).

Hosts: Dog food and foodstuffs (CMI, 1988).

Distribution: United Kingdom, Japan.

Notes: This species has a distinctive conidial ornamentation which is closest to that of *E. cristatum* (cf. Fig.37c). The distinct nature of this species is reflected in its colony appearance, which is typically lemon in colour when grown on Czapek Dox plus sucrose. *E. cristatum* shows a normal green growth which does not require additional sucrose.

It has not been possible to rear ascospores of sufficient maturity to compare with those of *E. cristatum*.

Eurotium cristatum (Raper & Fennell) Malloch & Cain, *Can. J. Bot.* **50**: 64 (1972).

Aspergillus cristatus Raper & Fennell, *The genus Aspergillus*: 169 (1965).

Anamorph: **Aspergillus cristatellus** Kozakiewicz, **sp. nov.**

Diagnosis Latina anamorphosi Aspergilli restricta in Raper & Fennell, *The genus Aspergillus*: 169 (1965).

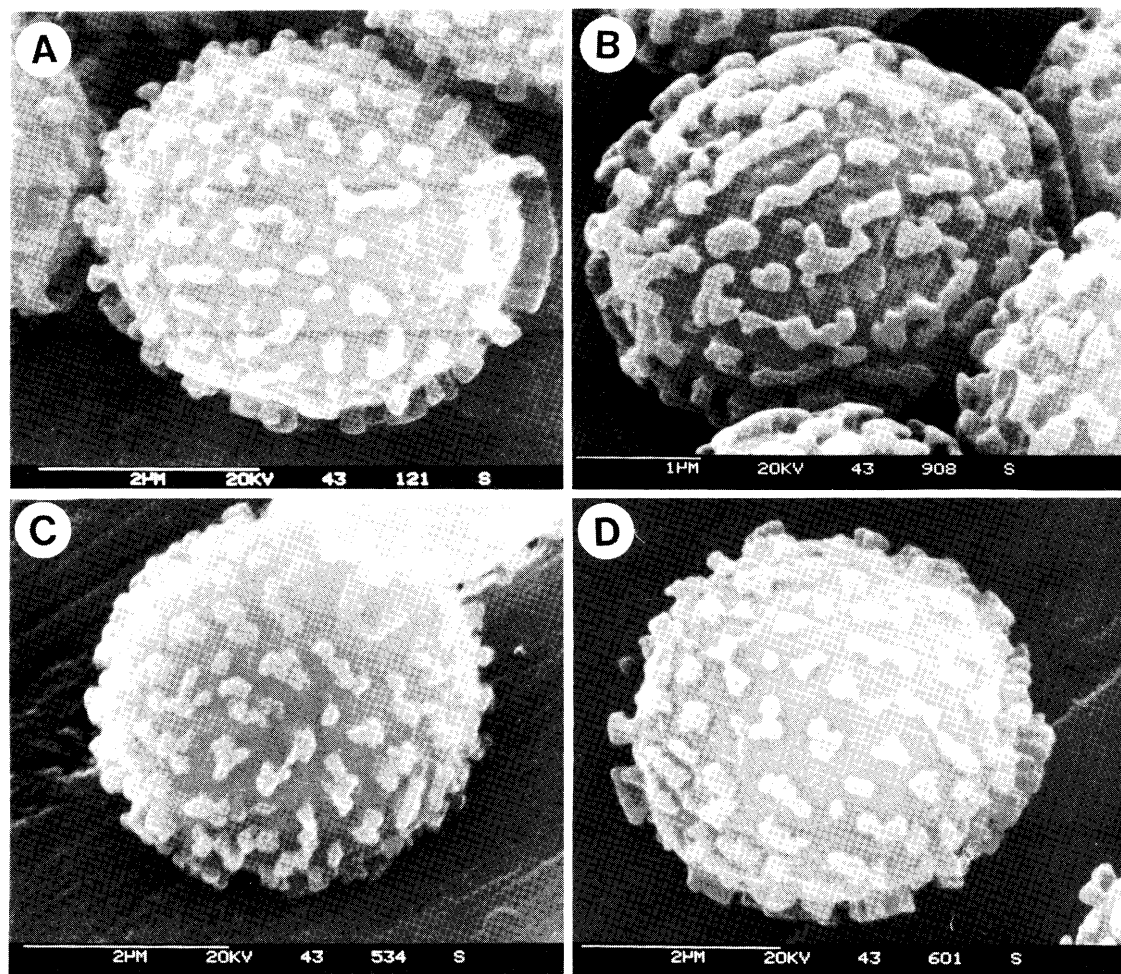


Fig. 40. A. *glaucus* group: conidial micrographs of *E. heterocaryoticum* and *E. amstelodami* used by Caten (1979) in genetic crossings. A, *E. heterocaryoticum* normal strain; B, *E. amstelodami* normal strain; C, *E. heterocaryoticum* brown A2 parent crossed with, D, white A1 parent to give the A9 F1 hybrid (Fig.41).

Holotypus cultura sicca IMI 172280 pro parte *Aspergilli* pertinans.

Illustrations: Fig.38a,b.

Description: *Conidia* tuberculate. *Conidiogenous cells* uniseriate. *Conidiophores* smooth, 200–350 μ m long. *Conidial heads* few, light grey blue-green, small. *Ascomata* maturing quickly, yellow. *Ascospores* with equatorial crests as pronounced thin delicate flexuose structures, hemispheres bearing distinct echines.

Type: South Africa: 1953, H.J. Swart (IMI 172280, holotype).

Hosts: Mushroom compost, foodstuff.

Distribution: U.S.A., South Africa, United Kingdom.

Notes: Within this category, both the conidium and ascospore of *E. cristatum* are distinct. On the basis of light microscopy, Pitt (1986) considered it to be conspecific with *E. spiculosum*. SEM of both states of both species are given in Fig.38. The principal distinctions separating them are the shape and ornamentation of conidia and the ornamentation on the convex walls of the ascospores.

Through the limitations of optical microscopy Pitt did not differentiate between the conical spines of *E. cristatum* ascospores and the reticulate ridges of *E. spiculosum* and failed to identify the furrow present in both species, which in the SEM micrographs appears far larger than the ornamentations. Similarly he did not differentiate between the tuberculate ornamentation of *E. cristatum* conidia and the almost lobate-reticulate pattern in *E. spiculosum*. There are also differences in overall shape of the conidia; in *E. cristatum* it is ellipsoidal and in *E. spiculosum* it is globose. Pitt (1986) referred to *E. spiculosum* conidia as 'ellipsoidal to short cylindroidal'.

Eurotium spiculosum Blaser, *Sydowia* **28**: 42 (1976) ['1974/1975'].

Anamorph: **Aspergillus spiculosus** Blaser, *Sydowia* **28**: 42 (1976) ['1974/1975'].

Illustrations: Fig.38c,d.

Description: *Conidia* tuberculate. *Conidiogenous cells* uniseriate. *Conidiophores* smooth, 700–850 µm long. *Conidial heads* numerous, green. *Ascomata* yellow to orange. *Ascospores* with equatorial crests thickened and moderately well-developed; hemispheres roughened into indistinct ridges.

Type: Spain: Badajoz, ex soil, 1971, P. Blaser (IMI 278376, holotype).

Hosts: Bread, groundnuts, hare's dung.

Distribution: Israel, Switzerland, Spain (Blaser, 1976).

Notes: Although on the basis of conidial form this species has been placed in the tuberculate category, it has already been noted that it is really intermediate between this and the lobate-reticulate category (cf. Fig.37).

Eurotium chevalieri Mangin, *Ann. Sci. nat., Bot., Sér. 9*, **10**: 361 (1909).

Aspergillus chevalieri (Mangin) Thom & Church, *The Aspergilli*: 111 (1926), a later homonym of *A. chevalieri*, Mangin, 1909.

Anamorph: **Aspergillus chevalieri** Mangin, *Ann. Sci. nat., Bot., Sér. 9*, **10**: 362 (1909).

Aspergillus allocotus Bat. & Maia, *An. soc. biol. Pern.* **15** (1): 184 (1957).

Aspergillus equitis Samson & W.Gams, *Advances in Penicillium and Aspergillus Systematics*: 36 (1986).

Illustrations: Fig.38e,f.

Description: *Conidia* lobate-reticulate. *Conidiogenous cells* uniseriate. *Conidiophores* smooth, 700–850 µm long. *Conidial heads* abundant, sage-green, to Andover green or slate olive (R. XLVII). *Ascomata* yellow, enmeshed in orange-red hyphae. *Ascospores* with equatorial crests thick, moderately expanded; hemispheres smooth, bearing occasional small echines.

Type: ?U.S.A.: ex coffee beans, 1916, C. Thom (IMI 211382, neotype).

Hosts: Stored cereals, fruit, coffee beans, cocoa, tobacco, water (CMI, 1988), dried pulses, nuts, dried meat and fish (Pitt & Hocking, 1985), rice and rice flour (Kurata *et al.*, 1968a,b; Saito *et al.*, 1974).

Distribution: Worldwide: U.S.A., United Kingdom, India, Ghana, Tanzania, Nigeria.

Specimens: United Kingdom: Berkshire, ex wheat, 1968, J. Clarke (IMI 140509); sine loc., 1933, P. Biourge (IMI 91867), type of *Aspergillus oriolus* Biourge and NRRL 4909, type of *Aspergillus allocutus* Batista & Maia.

Notes: A common 'stored produce' species, growing between 14 and 16% MC. There is some evidence that *E. chevalieri* may be mycotoxigenic. It has been implicated in bovine toxicity (Carll *et al.*, 1954), haemorrhagic syndrome in chickens (Schumaier *et al.*, 1961) and several other laboratory-orientated tests (Wyllie & Morehouse, 1977). *E. chevalieri* also produces the toxin gliotoxin (Wilkinson & Spilsbury, 1965; Rightsel *et al.*, 1964).

Closest to but distinct, both in form of conidium and ascospore, from *E. amstelodami*.

Eurotium amstelodami Mangin, *Ann. Sci. nat., Bot., Sér. 9*, **10**: 360 (1909).

var. **amstelodami**

Aspergillus amstelodami Thom & Church, *The Aspergilli*: 113 (1926).

Eurotium repens var. *amstelodami* Vuill., *Bull. Soc. mycol. Fr.* **36**: 361 (1920).

Eurotium vitis Novobranova, *Nov. Sist. niz. Rast.*, 1972: 175 (1972).

Anamorph: **Aspergillus vitis** Novobranova, *Nov. Sist. niz. Rast.* 1972: 175 (1972).

Aspergillus hollandicus Samson & W.Gams, *Advances in Penicillium and Aspergillus Systematics*: 33 (1986).

Illustrations: Fig.42a,b.

Description: *Conidia* lobate-reticulate. *Conidiogenous cells* uniseriate. *Conidiophores* smooth, 275–350 µm long. *Conidial heads* abundant, deep olive-green near ivy green (R. XLVII). *Ascomata* bright yellow. *Ascospores* with equatorial crest thickened, moderately pronounced; hemispheres bearing lobate-reticulate echines.