

## THE GENUS *THIELAVIA* ZOPF FROM INDIA

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18 species of *Thielavia* Zopf reported from India were studied at length based on the cultures, herbarium specimens and slides deposited at the international Mycological Institute, U.K. Textura epidermoidea, ascospore size and shape, germ pores and their position, appendages if any, conidial types and other related characters were taken into consideration along with cultural characters and nature of cleistothecia. After critical analysis a key has been proposed to facilitate identification. Brief descriptions, homonyms and synonyms and also taxonomic controversies were highlighted besides amending the genus description.

**Key words :** Fungi, *Thielavia*, taxonomy

*Thielavia* Zopf with *T. basicola* as its type is characterized in possessing non-ostiolate, glabrous or appendaged, dark coloured ascocarps with a peridium of textura epidermoidea, asci fascicled or irregularly disposed, clavate to globose, 4 to 8 spored, evanescent, with or without croziers; ascospores brown, smooth, one celled with one or two germ pores, ascospores neither dextronoid nor cyanophilous; conidia produced as simple phialoconidia, aleurioconidia or arthroconidia.

*Thielavia* differs from *Chaetomium* and other allied genera in lacking ostiolate ascomata. Species of *Thielavia* fruit readily on most culture media and known to occur as saprophytes on diversified habitats and rarely as parasites. Several contributions have been made on species of *Thielavia* Zopf (Apinis, 1930; Booth, 1961. Booth and Shipton, 1966; Douget, 1956; Emmons, 1930, 1932; Goehanaur, 1968; Lucas, 1949, Malloch, 1970; Malloch and Cain, 1973; Mehrotra and Bhattacharjee, 1966; Mehrotra and Mehrotra, 1962; Nicot and Longis, 1961; Rayss and Borut, 1958; Srivastava *et al.*, 1966; Udagawa, 1972; Udagawa and Kouhei, 1975; Von Arx, 1975 a,b).

Malloch and Cain (1973) have detailed out the characteristic features of twenty four species of the genus *Thielavia* and have recognised four basic ascospore shapes viz; radially symmetrical, bilaterally symmetrical and equilateral in longitudinal section, and irregular or inconsistent in shape possessing one or two apical to sub-apical or lateral germ pores. Mouchacca (1973) pointed out that *Thielavia* comprises of a heterogeneous group of fungi. Von Arx (1975 b) has described and presented a key to 14

species of *Thielavia* possessing only apical to subapical or lateral germ pore at one end only. He has proposed a new genus *Corynascus* for some species of *Thielavia* possessing one apical to subapical or lateral germ pore at each end. Von Arx (1975b) has stated that a germ slit can be observed as an inconspicuous longitudinal rim in *Thielavia boothii* Manoharachary and Ramarao (1973) and consequently transferred to *Coniochaetidium* as a new combination i.e. *Coniochaetidium boothii*.

Von Arx (1975 b) has treated *Boothiella* Lodhi and Mirza and *Thielaviella* Von Arx and Tariq Mahmood under *Thielvaia* and I agree with the proposal of Von Arx. Von Arx (1975 a) has erected a new genus, *Eremodothis* to accommodate *Thielavia angulata* Das (1962) possessing ascospores which are one celled and dark brown with out germ slits or germ pores.

So far eleven species of *Thielavia* have been reported on diversified habitats from India by various workers (Bilgrami *et al.*, 1971). Lodha (1974) has added four new species of *Thielavia* from India namely *Thielavia bispora*, *T. macrospora*, *T. ovalispora* and *T. minuta*, occurring on coprophilous habitats. *T. minuta* Lodha is a later homonym of *T. minuta* (Cain) Malloch and Cain (1973). Hence Hawksworth (1978) has proposed a new combination i.e. *T. minutissima* in accordance with Art 64. Pathak and Agrawal (1977) have published *Coniochaetidium coprophilum* possessing a germ slit on ascospores from India. Hawksworth (1978) has stated that the 'germ slits' were simply folds in collapsed ascospores and established that ascospores had single apical to subapical germ pore with the help of light microscopy and ISI -60



SEM. Hence it belongs to *Thielavia* in the sense of Von Arx (1975 b) and is consequently transferred by Hawksworth (1978) to *Thielavia* by proposing a new combination. The present paper deals with the broader concept of the genus *Thielavia* Zopf, descriptions and variations of *Thielavia* spp. reported from India besides proposing key for various species along with other isolates.

The isolates examined in the present investigation have shown non-ostiolate, simple or appendaged ascomata with peridium of textura epidermoidea. 4 to 8 spored asci and ascospores with one or two apical to subapical or lateral germ pores. Lodha (1974) has described a species viz. *Thielavia bispora* possessing two ascospored asci. In view of the above events an amendment is proposed to the genus description so as to give a broader concept of the genus *Thielavia*.

#### MATERIALS AND METHODS

In December 1977 I had the opportunity to examine many isolates of *Thielavia* Zopf received at International Mycological Institute, Ferry lane, Kew, Surrey, U.K. for identification from different parts of India. Monosporic cultures were raised on potato Dextrose Agar, Oatmeal agar and malt extract agar media from the available stock cultures and lyophilized cultures deposited at International Mycological Institute. Ascospore germination studies were conducted using hanging drop technique and also on 1% water Agar (Hawksworth, 1971). Herbarium specimens and slides were also screened. The fungal species were identified using standard manuals (Booth, 1961; Mouchacca, 1973; Nicot and Longis, 1961; Udagawa, 1963; Von Arx, 1975 a,b) and relevant literature. Original papers were referred whenever required.

#### SYSTEMATIC ENUMERATION AND DESCRIPTIONS

*Thielavia zopf* Verh. Bot. Vereins Prov. Brandenburg 18: 101, 1976; *Boothiella* Lodhi & Mirza, *Mycologia*, 54: 217, 1962; *Thielaviella* V Arx & Tariq Mahmood *Trans Byrit Mycol Soc.* 5: 611, 1968. Colonies spreading white or light to dark brown, often large or tufted, mycelium hyaline or rarely dark brown, septate, ascocarps borne on hyphae, non-ostiolate, spherical, glabrous, tomentose or setose/appendaged, peridium of 'textura epidermoidea; asci fascicled or irregularly disposed, ellipsoidal, cylindrical or clavate' globose, 2 to 8 spored, evanescent with or without croziers; ascospores brown, smooth, one celled,

with one or two apical to subapical or lateral germ pores, neither dextronoid nor cyanophilous, ellipsoidal, sometimes flattened on one side, globose, ovate to obovate or clavate, fusoid; conidia produced as simple phialo-conidia, aleurio-conidia or arthro-conidia, hyaline or brightly coloured, often absent.

I have examined several isolates of *Thielavia basicola* Zopf received at C.M.I. from India. It is observed that a gelatinous layer surrounding ascospore or ascospores with two germ pores as described by Booth (1961) could not be seen neither in the type specimen nor in freshly cultured isolates. Von Arx (1975) too has concluded in the same manner. In view of this the type species also needs amendment, hence amended.

1. *Thielavia basicola* Zopf Verh Bot Vereins Prov Brandenburg 18 101, 1876 *Thielavia renomnata* Paclt *parasitica* 7 : 110, 1951.

Ascocarps 80-160  $\mu\text{m}$ , dark brown, glabrous, non-ostiolate, with peridium 'textura epidermoidea, peridium 9-10  $\mu\text{m}$  thick, asci clavate to ellipsoidal, 8 spored, ascospores 9.6-12.0 x 5.6-8.0  $\mu\text{m}$ , ellipsoidal, one celled with one apical germ pore (Fig. 1).

On leaves of *Mentha arvensis* L., Lucknow, India A Hussain, 24.8.75 IMI 196465.

2. *Thielavia appendiculata* Srivastava, Tandon, Bhargava & Ghosh *Mycopath. Mycol. Appl.* 30 : 205, 1966.

Ascocarps non-ostiolate, 40.0-180.9  $\mu\text{m}$  in diam, globose, dark brown with peridium of textura epidermoidea, densely and uniformly with short brown, septate, smooth or slightly verrucose 4.8-40.0 x 2.4-3.6  $\mu\text{m}$  appendages, asci 25.0 - 32.0 x 11.5-13.2  $\mu\text{m}$ , irregularly disposed clavate asci, ascospores ellipsoidal with a subapical germ pore, 9.6-14.4 x 6.4 - 8.0  $\mu\text{m}$ , conidia absent.

The present isolate closely agrees with the type description. On leaves of *Punica granatum* L. (Lythraceae), India, R.N. Tandon, 19.3.1964. IMI 104944.

3. *Thielavia bispora* Lodha *Nova Hedwigia*, 361-366, 1974

Ascocarps non-ostiolate, globose, covered with few mycelial hairs, 200-250  $\mu\text{m}$  in diam, asci two spored, broadly clavate, evanescent, 19.2 - 24.0 x 12.5 - 16.8  $\mu\text{m}$ , ascospores globose, dark brown, smooth



with a round germ pore, 11.2-20.8  $\mu\text{m}$  in diam (Fig. 12). Isolated from goat dung, Jaipur, Rajasthan, B. C. Lodha, 10 July 1963 R.U.B.L. No. 297.

Lodha (1974) described *T. bispora* having the thick, leathery and opaque peridium, 2 spored asci and globose ascospores with a single circular germ pore. In view of this a critical observation of the type material is essential.

4. *Thielavia coactilis* Nicot ex Nicot and Longis *Comp Rend Hebd Seances Acad Sci* 253, 304 1961

Ascocarps 80.0-160.0  $\mu\text{m}$  in diam, globose, dark brown, glabrous with peridium of textura epidermoidea, asci clavate, 3 spored, 25.0-29.0 x 12.0-18.0  $\mu\text{m}$  ascospores 6.4-8.8 (11.2) x 5.6-8.0 (10.4)  $\mu\text{m}$ , ellipsoidal or broadly ovoid with a single apical germ pore, dark brown, conidia lacking (Fig. 3).

Isolated from *Triticum* dry leaves, Delhi, India, M. Rikhy, March, 1972, IMI 183987.

It is evident that the present isolate differs from the type in possessing slightly wider ascospores.

5. *Thielavia coprophila* (Pathak & Agrawal) D. Hawks. *Trans Br Mycol Soc*, 70 : 1978 = *Coniochaetidium coprophilum* Pathk & Agarwal *Curr Sci*, 46 393, 1977.

Ascocarps smooth with peridium textura epidermoidea, asci 8 spored, 20.0-31.0  $\mu\text{m}$  long, 15.0-21.0  $\mu\text{m}$  wide with apical to subapical germ pore.

Observed on excreta of Tiger in Zoo, Gwalior, India, 8 Oct. 1973, S C Agrawal, IMI 179850.

As the ascospores of this species have an apical to subapical germ pore it belongs to *Thielavia* in the sense of Von Arx (1975). The ascospores were studied in a ISI-60 SEM which left no doubt that the germ slits were simply folds in collapsed ascospores. A particular feature of this species is the four spored asci as only two other *Thielavia* with such asci previously been described viz. *T. thermophile* Fergus and Sinder, *T. tetraspora* (Lodha & Mriza) V Arx. A further feature of interest in *Thielavia coprophila* is the peridium of textura epidermoidea as in most species of the genus but with almost polygonal cells in surface view.

6. *Thielavia fimeti* (Fuckel) Malloch & Cain *Mycologia* 65, 064, 1973 = *Chaetomium fimeti* Fckl *Enum Fung Nass Ser* 491, 1961 - *Chaetomidium fimeti* (Fckl) Sacc *Syll Fung* 1 : 39,

1882. = *Chaetomidium subfimeti* Seth *Trans Brit Mycol Soc* 50 : 46, 1967, = *Thielavia subfimeti* (Seth) Malloch & Cain *Mycologia* 65 : 1070 1973.

Ascocarps superficial, brown to black, spherical to subspherical, 240.0-400.0  $\mu\text{m}$  in diam, non-ostiolate with pseudoparenchymatous peridium, covered with two types of hairs (a) long, straight or flexuous, unbranched, septate or smooth or with protuberances, thick walled dark brown 200-300  $\mu\text{m}$  long, 5-7  $\mu\text{m}$  wide (b) short, numerous, yellowish, brown, minutely roughened, septate 80-300  $\mu\text{m}$  long, 3-5  $\mu\text{m}$  wide appendages; asci 8 spored, clavate, 100-150 x 16-18  $\mu\text{m}$  paraphyses indistinct; ascospores lemon shaped, 9.6-12 x 5.6-6.4  $\mu\text{m}$ , flattened on two sides, subapiculate at both ends, one circular germ pore located at one end, conidia absent (Fig. 4).

Isolated from *Capsicum* root surface, Jodhpur, India, K Panwar, 26.4.73, IMI 174757. On *Pistachia vera* Ludhiana, J.S. Chohan, IMI 185610, IMI 116692, IMI 14341 I, Grassland soil, Jabalpur, India, P.D. Agarwal, 22.4. 71 IMI 160328.

No sharp differences exist between *T. fimeti* and *T. subfimeti* hence Udagawa (1975) has merged *T. subfimeti* with *T. fimeti*. I also agree with the opinion of Udagawa (1975). Though the type species is described to produce slightly longer and wider ascospores, the present fungus is treated conspecific with *T. fimeti* in view of its similarities in all other characters.

7. *Thielavia fragilis* (natarjan) V ARx *Studies in Mycology*, 8 1975 Baarn ? *Chaetomidium fragile* Natarajan *Proc. Indian Nat. Sci Acad. Sect B* 7 124, 1971.

Ascocarps non-ostiolate, spherical, light brown with textura epidermoidea type of peridium, 80-200  $\mu\text{m}$  in diam, asci irregularly disposed, clavate; ascospores rather clavate or obovate, often irregular in shape, with a distinct apical germ pore, 8.0-15.2 x 5.6-8.0  $\mu\text{m}$  (Fig. 5).

Isolated from rhizosphere soil of *Pennisetum typhoides* Stapf, India, Madras University Botanical Garden., 27.10.1966 & 30.9.1972, Natarjan. This isolate closely agree with the type description.

8. *Thielavia minor* (Rayss & Borut) Malloch & Cain *Mycologia*, 65 1065, 1973. = *Thielavia terricola* (Gilman & Abbott) Emmons form a minor Rayss & Borut *Mycopathol Mycol*



*Appl 10 160*, 1959.

= *Thielavia terricola* (Giman & Abbott) Emmons  
Var. *minor* (Rayss & Borut) Booth Mycol Pap 83  
3, 1961.

Ascocarps are upto 200  $\mu\text{m}$ , globose, non-ostiolate, black with a pseudoparenchymatous peridium, asci 20.0-25.0 x 12.0-16.0  $\mu\text{m}$ , ellipsoidal, 8 spored, ascospores ellipsoidal, 8.0-13.6 x 6.4-8.0  $\mu\text{m}$  with a single apical germ pore, dark brown, aleurioconidia present in some strains (Fig. 6).

Isolated from soil, Kamal India, Gorakhpur, 9.12.75, IMI 199573; IMI 190566 piper grain, India, CPCRI, 8.1.75; IMI 190219. Kanpur, I.B Pandey, Leaf of *Psidium guajava* L. IMI 151038, Yadav, seeds of *Sesamum orientale* L. India; IMI 168085, *Triticum* grains, Jabalpur, L.K. Joshi, 14.8.72; IMI 212958, V. Ravindranath, Hyderabad, 11.4.77, soil, IMI 1957282, grass land soil, Jabalpur, P. Agarwal, 28.4.77.

Von Arx (1975) has treated it conspecific with *T. basicola*. There are no appreciable differences between *Thielavia minor* and *Thielavia basicola*. The only peculiarity of the present isolate is that some of them had conidial states. In view of the minor differences from that of *T. basicola*, I suggest to treat it under *T. basicola* only as synonym.

9. *Thielavia minutissima* (Lodha) Hawksworth *Trans Brit Mycol Soc.* 70 1978  
= *Thielavia minuta* Lodha *Nova Hedwigia*, 361-366, 1974.

Ascocarps black, globose, 105-150  $\mu\text{m}$  in diam, covered with mycelial hairs, asci 8 spored, broadly clavate, unitunicate, evanescent; ascospores irregularly arranged, oval to ellipsoidal or lemon shaped with narrowly rounded ends 34.5 - 38.4 x 19.0 - 22.0  $\mu\text{m}$ , smooth, olivaceous brown with a germ pore at one end (Fig. 15).

Isolated from rat dung, B C Lodha, Jodhpur, Rajasthan, 1962, RUBL 503.

10. *Thielavia ovalispora* Lodha *Nova Hedwigia* 361-366, 1974.

Ascocarps globose, black, 240-300  $\mu\text{m}$  8 spored, globose to broadly clavate, evanescent, ascospores irregularly arranged, oval, 9.6-12.0 x 6.4 - 7.6  $\mu\text{m}$ , olivaceous grey, thick walled, subapiculate with a distinct thin walled and hyaline region 1.5 x 1.0  $\mu\text{m}$  at each end looks like germ pore.

Isolated from horse dung collected at Mt. Abu, Rajasthan, 3rd Oct. 1961, Lodha B C, RUBL No. 265.

Lodha (1975) stated that it resembles *Thielavia basicola* Zopf but differs in possessing thin walled hyaline region at each end. Therefore it is suggested that the type culture has to be examined critically to assign it to a definite taxon.

11. *Thielavia macrospora* Lodha *Nova Hedwigia*, 361-366, 1974.

Ascocarps black, globose, 105-150  $\mu\text{m}$  in diam, covered with few mycelial brown hairs, asci 8 spored, broadly clavate unitunicate, evanescent, ascospores irregularly arranged, oval to ellipsoidal or lemon shaped with narrowly rounded ends, 34.5.38.4 x 19.0 22.0  $\mu\text{m}$ , smooth, olivaceous brown with a terminal germ-pore at one end (Fig. 13).

Isolated from rat dung, B C Lodha, Jodhpur, Rajasthan 1962, RUBL 503.

Description and figures are based on Lodha's observation (1974).

12. *Thielavia sepedonium* Emmons *Bull Torrey Bot Club* 59, 417, 1932 = *Thielavia lutescens* Kanyschko, *Novost Sist Niz Rast* 116, 1965. = *Thielavia sepedonium* Emmons var *minor*. Mehrotra & Bhattachargee *Antonie Van Leeuwenhoeck Ned Tijdschr Hyd.* 32 391, 1966 = *Corynascus sepedonium* (Emmons) Von Arx *Studies in Mycology* No. 8 CBS, 1-27, 1975.

Ascocarps non-ostiolate, upto 160  $\mu\text{m}$  in diam, globose, brown to dark brown, peridium of textura epidermoidea with characteristic reticulate engraving, asci 25.0-35.0 x 17.0-25.0  $\mu\text{m}$ , 8 spored, ascospores 9.6 - 17.6 x 7.2-10.5  $\mu\text{m}$  with germ pore at each end, ellipsoidal, rarely flattened at one side, dark brown, conidia globose, 4.0-11.2  $\mu\text{m}$  in diam, smooth or echinulate, bright yellow, produced in single or in catenate aleurioconidia, phialo-conidia were present (Fig. 7).

This isolate shows lower range of ascospores than the type material. Isolated from the fruit of *Ficus glomerata* Roxb. Allahabad, India, Chandra, 27.11.63 IMI 103802.

Soil, Allahabad, pH 6.8-7.9, B.S. Mehrotra, 1968, IMI 136625.

Isolated from *Sesamum indicum* L. seeds, India.

Ishwaque Ahmed, 10.9. 1975. IMI 198280.

Isolated from soil, Sagar, M.P. India S.B. Saksena, 27.3.74, pH 7.2. IMI 183768.

Isolated from soil, Gorakhpur, Dr. Kamal, Dec. 1971, pH 6.8 IMI 166193.

Isolated from soil, Jaipur, pH 8.2. R.L. Mathur, 5.11.65, IMI 115933.

Isolated from soil, Varanasi, Ramdayal, 22.1.65, IMI 111062.

Isolated from Maize field soil, Hyderabad, Ram Reddy, 23.2.1963, IMI 19496

Isolated soil, Gorakhpur, 16.8.63 IMI P.C. Mishra, IMI 102019.

Isolated from soil, Annamalai University, Rangaswami, 17.4.1962, IMI 92839

Isolated from soil, Varanasi, R.S. Dwivedi, 6.12.1975. IMI 199526.

Isolated from soil supporting *Crotalaria juncea* L. (Ascospores 12.0-17.6 x 6.0 -70  $\mu\text{m}$ ) A.K. Paul, IMI 204161

Isolated from *Glycine* sp. Pantnagar, Y.L. Nene, 1969, IMI 144329. Phialoconidia present, Ascospores 10.4-15.2 x 8.0-8.8  $\mu\text{m}$ . No reticulate engravings were observed in the wall cells of peridium of textura epidermoidea. Hence, this isolate has to be shifted to some other species of the genus *Thielavia*. The presence of engravings in the peridium wall cells has to be considered as one of the specific characters in view of its constant presence and consistent appearance in all the isolates observed.

Isolated from seeds of *Lens esculenta* Moench, India, K S. Bilgrami, 1.7.75, IMI 195102.

Isolated from seeds of *Lens esculenta* D.K. Nema, 25.4.77, Jabalpur, IMI 21350

Isolated from seeds of *Sorghum vulgare* L. India, R.B. Sona, 30.10.75, IMI 198369.

Isolated from rhizosphered soil of *Vitis vinifera* L. M.A. Salam, Hyderabad, 29.1.65, IMI 11806.

Isolated from soil, Gorakhpur, Kamal, 13.9.73, IMI 179104.

Isolated from decomposing litter, India, R.S. Mehrotra, IMI 201183. Besides the above IMI 179104.

213228, 208020, 209591, 211971, 201981, 213381, 204318, 172185 also have been observed.

13. *Thielavia peruviana* (Gochenaour) Malloch and Cain *Mycologia*, 1067, 65 1973. = *Chaetomidium peruvianum* Gochenaour *Mycologia*, 60, 118, 1968.

Ascocarps 80-120  $\mu\text{m}$  in diam, globose, dark brown to black, covered with uniformly short hairs with a peridium of texture epidermoidea, ascocarp hairs 8.0-14.4 x 2.4-3.2  $\mu\text{m}$ , brown, rough or smooth, septate, asci 8 spored, 32-43 x 10-13.5  $\mu\text{m}$ , clavate, ascospores 11.0-13.8 x 6.2-80.  $\mu\text{m}$ , fosooid with apical to sub-apical germ pore at one end, aleurio-conidia present, 3.2-4.8  $\mu\text{m}$  in diam (Fig. 8.).

Isolated from *Vallisneria spiralis* spr., Allahabad, IMI 169570, M P Tandon, 28.9.1972.

It is evident that the present isolate differs from the type in the size of ascospores and shows resemblances to *Thielavia appendiculata*. Therefore it can be merged with *T. appendiculata* after the critical examination.

14. *Thielavia phyllactinea* (Bainier) Malloch and Cain *Mycologia*, 65 1067, 1973. = *Chaetomidium phyllactneum* Bainier *Bull Soc Mycol France*, 25 193, 1969

Ascocarps are upto 200  $\mu\text{m}$  in diam, globose. black, covered with one type of hairs, hairs upto 260  $\mu\text{m}$  long, gradually tapering from apex to just above and abruptly swollen to 12.0  $\mu\text{m}$  at the base, rigid, straight, unbranched, non-septate, dark brown, evenly scattered on the surface, asci ovoid, twice as long as broad, ascospores 16-24 x 8.8 -13.6  $\mu$ , fusiform to lemon shaped with one germ pore, dark brown, conidia unknown (Fig. 9).

Isolated from grassland soil, pH 7.2, Jabalpur, India, P.D. Agarwal, 22.9.1971, IMI 160306.

The size and shape of the ascospores of the present isolate fall in the range of the measurements described for the type species.

15. *Thielavia setosa* Dade *Trans Brit Mycol Soc*, 21, 16, 1937.

Ascocarps superficial, globose, upto 400  $\mu\text{m}$  diam, black, with simple appendages 72-230 x 3.7-7.2  $\mu\text{m}$ , with peridium of textura epidermoidea, asci 30-54 x 27-32  $\mu\text{m}$ , clavate to ovate, ascospores olivaceous green to dense black, ellipsoid, with one apical germ pore and a truncate end, 21.6-28.8 x 10.8 -14.4  $\mu\text{m}$ .



Isolated from rhizosphere soil of *Vetiveria zizanioides* Nashs, Botany Department, Banaras Hindu University, Varanasi, R.S. Dwivedi, pH 7.2.1962.

In general this agrees with the type species but differs in possessing larger ascospores.

16. *Thielavia variospora* Cain *Canad J Bot.* 39, 1234, 1961.

Ascocarps globose, upto 250 µm in diam, black, glabrous, with peridium of textura epidermoidea, asci globose to ellipsoidal, oval 8 spored, ascospores ellipsoidal, oval to angular, reniform, lacking a consistent symmetry, 6.4-16.0 x 5.6-8.0 µm with a single apical or lateral germ pore, conidia lacking (Fig. 11).

Isolated from fruits of *Momordica charantia* L. India, J S Chohan, 10.9.74 IMI 188156.

It closely agrees with the description given by Cain (1961).

17. *Thielavia terricola* (Gilman & Abbott) Emmons *Bull Torrey Bot Club* 57, 124, 1930. = *Conithyrium terricola* Gilman & Abbott) Emmons *Lowa state coll J. Sci.* 1, 267, 1927. = *Anixiopsis japonica* Saito & Minoura *J. Ferment Technol* 26, 47, 1948.

Ascocarps upto 250 µm in diam, glabrous dark brown, with a peridium of textura epidermoidea, asci clavate, 25-42 x 14-17 µ, short, stipitate, 8 - spored, ascospores ellipsoidal, 9.6-18.4 x 7.2-9.6 µm with an apical germ pore at one end, dark brown to black, conidia lacking (Fig. 10).

Isolated from *Abelmoschus esculentum* W & A, R Day, 30.7.73, IMI 179986.

In the present isolate the ascospores are slightly larger than the type. Some isolates have shown the presence of conidia on simple phialides, aleurioconidia or arthroconidia.

IMI 167491, *Capsicum annum* L., Udaipur S. Porwal, 7.7. 72; IMI 83657 Jute fabric, S N Basu, 18.11.60; IMI 16956 *Cordia dichotoma* Forst fruit, Allahabad, MP Tandon, 28.9.72; IMI 193037 *Cucumis melo* L. India, P S Chohan, 7.4.72; IMI 950199 *Dahlia variabilis* Desf. leaves, Allahabad, R N Tandon, 8.8.62; IMI 185115 *Phaseolus vulgaris* L., Jabalpur, 27.5.74; IMI 103996 *Eugenia jambolana* Lamk, Jodhpur, K S Bilgrami, 16.12.63; IMI 104951 Fruit of *Ficus*, R N Tandon, Allahabad, 19.3.64; IMI 133191 *Lagestroemia* sp., Jodhpur, 1968; IMI 31513 Discoloured rice seed, India, K Ramaiah, 10.7.48; IMI

49115 India, IMI 131929 field soil of Rice, B K Vaidehi, Hyderabad 8.8.67; IMI 179676 & IMI 198241 *Sesamum indicum* L., Ishwaque, Ahmed, 10.9.75; IMI 112031 & IMI 112053 *Vitis vinifera* L., Rhizosphere, Hyderabad, 29.165; IMI 179851 During, India, Saugar (M.P.) S C Agarwal, 8.10.73; IMI 179867 Dung, India, 8.10.73; IMI 179369 Deteriorating spices, Dr. Kamal, India, 30.8.73; IMI 172181 soil, Jabalpur, India, 27.12.72, L.K. Joshi; IMI 206897 sterilized soil, Haryana, R. N. Srivastava, 15.9.76; IMI 169213, Groundnut soil, Ludhiana, 14.9.72; IMI 206916 soil, Gwalior, K S Chouhan, 15.9.76; IMI 205862 soil, Varanasi, Chakrabarty, 30.7.70; IMI 157283 Grassland soil, Jabalpur, India P D Agarwal, 28.4.71; IMI 147881 Soil, Jabalpur, India, J Chalos. IMI 128930 soil, Agra, S Sinha, India, 23.8.67; IMI 107974 soil, Agra, India, Chouhan, 17.7.64; IMI 216838 From Ravines, R K S Chouhan, Gwalior, 15.9.77; IMI 156400 soil, Poona, India, S.P. Capoor 29.3.71; IMI 192318 Soil, India Joshi, 5.3.1975; IMI soil, India, 1.7.73; IMI 202504 soil, India, M L Sonar, 24.3.76 (Controversial Isolate). IMI 184096 *Cucumis melo*, Allahabad, M P Tandon, 19.4.74; IMI 170991 soil of *Arachis hypogea* L. Ludhiana, J S Chohan, 28.10.72; IMI 98992 Poultry, India, Singh, 11.2.73 Excluded species.

18. *Thielavia soppitti* Crossland *The Naturalist Hull* p 7, 1900

Cleistothecia globose, dark brown to black, 130-200 µm in diam, peridium of irregular dark brown cells, asci globose to sub-globose, 30-35 µm in diam, ascospores broadly fusoid to elliptical with symmetrical convex sides, olive brown to dark brown, 20-26 x 13-17 µm, germ pores present at both ends.

Isolated from soil, Delhi.

Behera *et al* (s1973) has described *T. soppitti* from India but no deposition was made at CMI. Malloch and Cain (1973) and Doguest (1956) have regarded it as a *Melanospora*.

From the description it is evident that it fits in *Thielavia*, but a closer examination of the isolate is essential hence I reserve my comments regarding it.

#### KEY TO SPECIES OF INDIAN THIELAVIA

Ascospores with a single germ pore at one end 1  
Ascospores with one germ pore at each end 2

1(A) Ascocarp smooth, ascus with 4 ascospores  
(i) Ascospores ellipsoidal (20-31 x 15-21 µm) with an



apical to sub-apical germ pore at one end - *Thielavia coprophila*

(B) Ascocarp smooth, ascus with two ascospores

(i) ascospores radially symmetrical (globose), 11.2-20.8  $\mu\text{m}$  in diam, with one germ pore - *Thielavia bispora*

(C) Ascocarp smooth, ascus eight spored

(i) ascospores ellipsoidal (9.6 - 12.0 x 5.6 - 8.9  $\mu\text{m}$ ) with an apical germ pore - *Thielavia basicola*

(ii) ascospores ellipsoidal (9.6 - 18.4 x 7.2 - 9.6  $\mu\text{m}$ ) with one apical germ pore, with or without conidia - *Thielavia terricola*

(iii) ascospores (34.5-38.4 x 19.0 - 22.0  $\mu\text{m}$ ) oval to ellipsoidal or lemon shaped with an apical germ pore - *Thielavia macrospora*

(iv) ascospores ellipsoidal to broadly ovate (6.4 - 11.2 x 5.6 - 10.4  $\mu\text{m}$ ) with an apical to sub-apical germ pore - *Thielavia coactilis*

(v) ascospores nearly obovate to clavate or lacking a consistent symmetry with one apical germ pore (8.0-1.52 x 5.6 - 8.0  $\mu\text{m}$ ) - *Thielavia fragilis*

(vi) ascospores irregular in shape (6.4 x 6.0 x 5.6 - 8.0  $\mu\text{m}$ ) with an apical or lateral germ pore at one end - *Thielavia variopora*

(D) ascocarps appendaged, ascus 8-spored

(i) ascospores ellipsoidal (9.6-14.4 x 6.4 - 8.0  $\mu\text{m}$ ) with one subapical germ pore - *Thielavia appendiculata*

(ii) ascospores ellipsoidal or dorsiventrally flattened (20- 31 x 15-21  $\mu\text{m}$ ) with one apical germ pore - *Thielavia fimeti*

(iii) ascospores fusoid (11.0-13.8 x 6.2 - 8.0  $\mu\text{m}$ ) with one apical to sub-apical germ pore - *Thielavia peruviana*

(iv) ascospores fusiform or lemon shaped (16.0-24.0 x 8.8 - 15.6  $\mu\text{m}$ ) with one apical germ pore - *Thielavia phyllactinea*

2(A) ascocarp smooth, ascus 8-spored

(i) ascospores oval (4.8-7.2 x 4.0-6.9  $\mu\text{m}$ ) with one apical germ pore at each end - *Thielavia minutissima*

(ii) ascospores oval (9.6 - 12.0 x 6.4 - 7.0  $\mu\text{m}$ ) with one thinwalled circular hyaline region at each end and looks like germ pore - *Thielavia ovalispora*

(iii) ascospores ellipsoidal (9.6-17.6 x 7.2-10.5  $\mu\text{m}$ ) with one germ pore at each end - *Thielavia sepedonium*

(B) ascocarps appendaged, ascus 8-spored

(i) ascospores ellipsoidal (21.6-28.8 x 10.8-14.4  $\mu\text{m}$ ) with an apical germ pore at each end - *Thielavia setosa*

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## REFERENCES

- Apinis A E 1963 Occurrence of thermophilous microfungi in certain alluvial soils near Nottingham. *Nova Hedwigia* 5: 57-78.
- Bilgrami K S, S Jamaluddin & M A Rizwi 1991 *Fungi of India*, list and References second Revised enlarged edition, Today & Tomorrow, printers & Publ. 1988.
- Booth C 1961 Studies of pyrenomycetes VI. *Thielavia* with notes on some allied genera. *Mycol Pap* No. 83 15 p
- Both C & W A Shipton 1966 A *Thielavia pilosa* sp. nov., with a key to species of *Thielavia*. *Trans Brit Mycol Soc* 49 665-667
- Butler E J & G R Bisby 1960 *The Fungi of India* (Revised by R S Vasudeva) ICAR, New Delhi publication.
- Das A C 1962 New Species of *Thielavia* and *Sordaria*. *Trans Brit Mycol Soc* 45 545-546.
- Doguet G 1956 Le genre *Thielavia* Zopf. *Fev Mycol Suppl Colon* 21 1-21.
- Emmons C W 1930 *Coniothyrium terricola* proves to be a species of *Thielavia*. *Bull Torrey Bot Club* 57 123-126.
- Emmons C W 1932 The development of the ascocarp in two species of *Thielavia*. *Bull Torrey Bot Club* 59 415-422.
- Gochenaour S E 1968 *Chaetomidium peruvianum* sp. nov. *Mycologia* 60 1118-1122.
- Hawksworth, DL 1978 *Coniochaetidium coprophilum* A species of *Thielavia*. *Trans Br Mycol Soc* 70 118-119.
- Lodha B C 1974. Studies on coprophilous fungi III *Thielavia*. *Nova Hedwigia* 47 361-366

- Lucas G B 1949 Studies on the morphology and cytology of *Thielavia basicola* Zopf. *Mycologia* **41** 553-560.
- Malloch D 1970 New concepts in the Microascaceae, illustrated by two new species. *Mycologia* **62** 727-740
- Malloch D & R F Cain 1973 The genus *Thielavia*. *Mycologia* **65** 1055-1077.
- Manoharachary C & P Ramarao 1973 *Thielaviaboothii* sp. nov. from pond mud. *Trans Brit Mycol Soc* **61** 196-198.
- Mehrotra B S & M Bhattacharjee 1966 A new variety of *Thielavia sepedonium* Emmons Antonie van Leeuwenboek. *Ned Tijdschr Hyg* **32** 389-392.
- Mehrotra B S & B R Mehrotra 1962 *Thielavia sepedonium* Emmons from India. *Curr Sci* **31** 385-386.
- Mouchancca J 1973 Lgs *Thielavia* des sols aides especes noveles et an alyse generique. *Trimert Soi Mycol Fr* **89** 295-311.
- Nicot J & D Longis 1961 Structure des spores et organisation des pertheques des deux *Thielavia* du soil. *Comp Rend Hebd Seances Acad Sci* **253** 304-306.
- Pathak R & S C Agarwal 1977 A new species of *Coniochaetidium* from India. *Curr Sci* **46** 393.
- Rayss T & S Borut 1958 Contribution to the knowledge of soil fungi in Israel. *Mycopath Mycol Appl* **10** 142-174.
- Srivastava M P, R N Tandon S N Bhargava S N & A K Gosh 1966 Studies on fungal diseases of some tropical fruits IV. Some new fungi. *Mycopath Mycol Appl* **30** 203-206.
- Udagwa S 1963 Notes on some Japanese Ascomycetes. *J Trans Mycol Soc Japan* **4** 94-102.
- Udagwa S & F Kouhei 1975 materials for the fungus flora of Japan. *Trans Mycol Soc Japan* **26**(3) 215-225.
- Von Arx J A 1975a On *Thielavia angulata*, some recently described *Thielavia* species. *Kavaka* **3** 33-36.
- Von Arx J A 1975b On *Thielavia* and similar genera of ascomycetes *Studies in Mycology*. **8** 1-29.