II. Morphological study of coprophilous and other microfungi in the present study

1. ***Absidia corymbifera*** (Cohn.) Sacc. & Trotter, 1912

   Specimen examined: KUFC 2711 (buffalo), 2715 (camel), 2737 (cow) and 2742 (cow)

   Reference: Domsch *et al*., 1993

Colonies on PDA, reaching 9 cm in diam. at 28 ^{o}C, white to pale gray. Sporangiophores with columellae, arising singly from stolons and bearing several branches. Sporangiospore ovoid to globose, hyaline, 3-4.5 x 2.5-3.3 μm.

A. corymbifera isolated from rhizosphere soil of oak, wheat, barley, oat and groundnut; on dung of rabbits, cattle and mules; in earthworm casts; on bat guano (Domsch *et al*., 1993).

2. ***Acremonium* spp.** Link ex Fr., 1821

   Specimen examined: KUFC 2873 (barking deer); 2874, 2876, 2881 (cow) and 2883 (deer)

   Reference: Domsch *et al*. (1993)

Acremonium sp. (KUFC 2873): Colonies on PDA, reaching 3.5 cm diam. in 7 days at 28 ^{o}C. Mycelium white to pale pink, reverse uncoloured. Conidiophores mostly simple orthotropic. Phialides arising from submerged tip without a conspicuous collarette, wall hardly thicker than that of the subtending hyphae, 15-20 μm long,

tapering from 2.0-3.0 μm, near the base to 0.8-1.3 μm. Conidia in strongly slimy heads, ellipsoidal, smooth, thick-walled, 3-4 x 1-1.2 μm.

3. ***Alternaria alternata*** (Fr.) Keissler., 1912

Specimen examined: KUFC 2885,2887 (buffalo); 2893, 2896, 2898, 2901, 2903, 2904, 2906, 2909 (cow); 2911 (goat) and 2913 (horse)

Reference: Ellis (1971)

Colonies on PDA, reaching 9 cm in diam. in 7 days at 28 ^{o}C. Mycelium black. Conidiophores arising singly, golden brown, up to 50-55 μm long, 3-5 μm thick. Conidia formed in long, chains, obclavate or ovoid, with a short cylindrical beak, golden brown, up to 8 transverse and several longitudinal septa, 25-55 x 10-16 μm.

Twelve isolates of *A. alternata* were found, mostly from cow dung (8 isolates), followed by buffalo (2), goat (1), horse (1) (Table 10). This species was recorded as an extremely common saprophyte found on many kinds of plants and other substrates including foodstuffs, soil and textiles (Ellis, 1971). Feng-Qin *et al.* (2001) reported the production of mycotoxins alternariol and its monomethyl ether, altenuene, altertoxin and tenuazonic acid by *A. alternata* from Chinese weathered wheat kernels, polished rice and durum wheat grains. These mycotoxins included Logrieco *et al.* (2003) reported toxigenic *A. alternata* strains associated with tenuazonic acid and alternariols which were commonly found in black mound of tomato, black rot of olive and citrus, black point of small cereals, and black mound of several vegetables from the Mediterranean area.

4. ***Arthrinium phaeospermun*** (Corda) M. B. Ellis, 1965 (Figure 10)

Specimen examined: KUFC 2888 (barking deer); 2890, 2891, 2895, 2902, 2905, 2907, 2910, 2912 (deer); 2916, 2918 (elephant) and 2920 (goat)

References: Ellis (1971), Seifert *et al*. (1983), Domsch *et al*. (1993)

Colonies on PDA, reaching 9 cm diam. in 7 days at 28 ^{o}C, with large numbers of white mycelium mats (Figure 10A). Conidiophore mother cells lageniform, 5-7 x 3-6 μm. Conidiophores erect ascending, cylindrical, smooth, colourless. Conidia lenticular, dark brown with a hyaline band at the junction of the two sides, 8-10 x 5-8 μm (Figure 10B).

A. phaeospermun has been reported very common on plant and many other substrates (Eill, 1971). Seifert *et al*. (1983) reported that this fungus was found from millipede pellets. *A. phaeospermun* has been recorded to contaminate pasteurised apple juice and ready to eat airline meals. It has been isolated at low levels from paddy rice, mung beans, soybeans and cashews in Thailand (Pitt and Hocking, 1997). This species has also been reported as the cause of cutaneous infection and onychomycosis (De Hoog *et al*., 2000; Zhao *et al.*, 1997). The fungus can produce 3–nitropropionic acid that toxic to nervous membrane (Wei *et al*, 1994). However, *A. phaeospermun* has been reported as the causal agent of kernel blight of barley (Matinez *et al*., 1992). In Thailand, Manoch *et al.* (2001) isolated *Arthrinium* sp. from soil in Khanchanaburi, bamboo soil in Phetchaburi and organic debris in Nakhon Ratchashima.

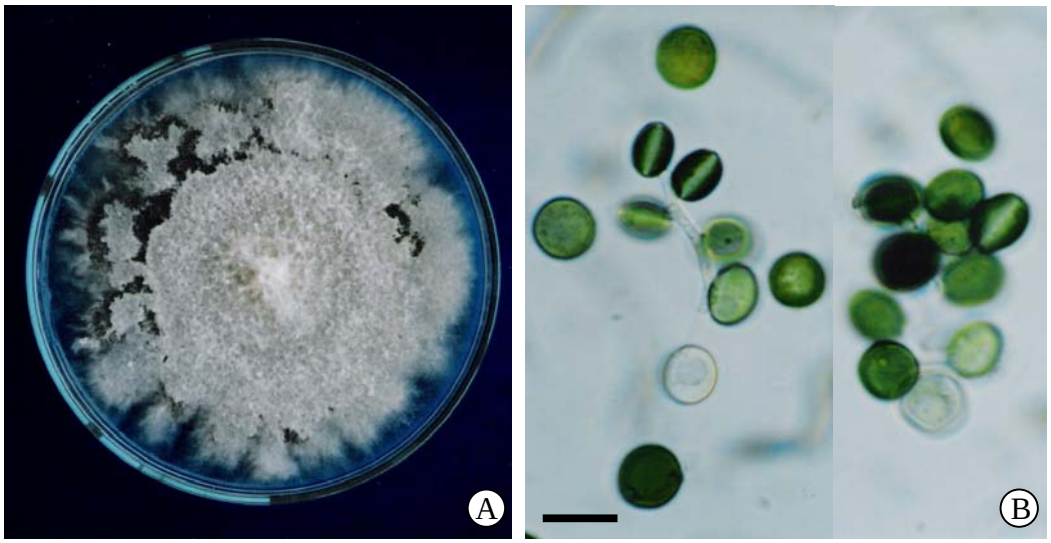


Figure 10 ***Arthrinium phaeospermum*** (Corda) M. B. Ellis. (KPFC 2890)
A. Colony on PDA, 7 days at 28 °C and B. Conidiophores and conidia (bar = 10 μm).

5. ***Arthrobotrys oligospora*** Fres., 1850 (Figure 11)
Specimen examined: KUFC 2892 (cow) and 2894 (deer)
References: Bell (1983), Seifert *et al*. (1983)

Colonies on PDA, reaching 9 cm diam. in 7 days at 28 °C (Figure 11A). Mycelium hyaline to pale pink. Conidiophores arising from fasciculate aerial hyphae, unbranched, 300-400 μm long, bearing several conidiferous nodes where the conidia are borne on short blunt denticles. Conidia hyaline, 2-celled, obovoid to pyriform, broadest in longer apical call, 25-28.5 x 16-19 μm (Figure 11B).

A. oligospora was reported as nematode trapping fungus (Jaffee, 2004; Migunova and Byzov, 2004). Seifert *et al*. (1983) recorded that *A. oligospora* is a true

coprophilous hyphomycete found on sheep, frog, bird and horse dung (Seifert *et al*., 1983). Bell (1983) stated that this fungus developed well on moist dung where there was abundant nematode worms.

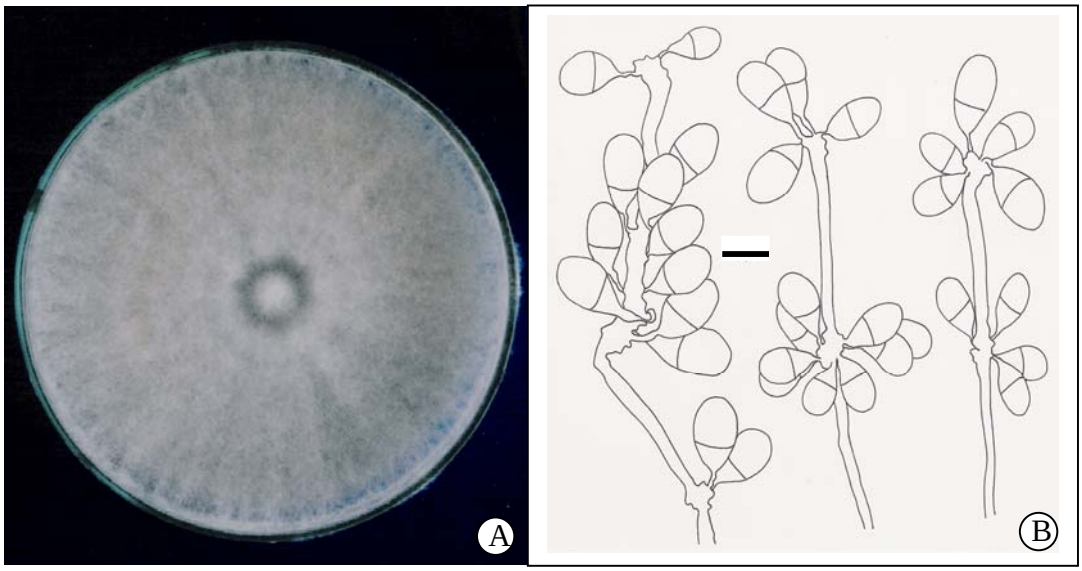


Figure 11 ***Arthrobotrys oligospora*** Fres. (KUFC 2894)

A. Colony on PDA, 7 days at 28 ^{o}C and B. Camera lucida drawings of conidiophores and conidia (bar = 10 μm).

6. ***Ascobolus albidus*** P. Crouan and H. Crouan, 1858 (Figure 12)

Specimen examined: KUFC 2452 and 2453 (elephant)

References: Bell (1983), Richardson & Watling (1997)

Colonies on PDA growing slowly, reaching 1.5-2.0 cm diam. in 7 days at 28 ^{o}C. Mycelium whitish brown, submerged, forming apothecia in 12-14 days. Apothecia submerged, colourless to pale yellowish, then dotted with the dark-colored spores (Figures 12A, 12B, 12D). Asci 8-spored, clavate, 180-220 x 30-35 μm (Figure 12C). Ascospores ellipsoidal, 20-30(33) x 10-15 μm, golden brown, ornamentation consisting of anastomosing rows of striations parallel to the long axis of the spore (Figure 12E).

Richardson and Watling (1997) described 21 species of *Ascobolus*, while 12 species were observed on dung in New Zealand (Bell 1983). *Ascobolus albidus* was found on cervid and lagomorph dung (Bell 1983). Bell (2005) reported that *Ascobolus albidus* was the only species found on five types of dung including rabbit, brumby, eastern gray kangaroo, wombat and swamp wallaby in Australia. Richardson (2001a) reported *Ascobolus albidus* on sheep, deer, cattle, rabbit, hare and grouse collected from Morocco. van Brummelen (1967) reported *Ascobolus demangei* and *A. siamensis* from goat dung, Uthai Thani Province. Somrithpol and Hywel-Jones (2002) recorded 8 isolates of *Ascobolus* spp. from wildlife including sambar deer, barking deer, Asain elephant and cattle dung from Northeastern Thailand. In this study, two isolates of *Ascobolus albidus* were found on elephant dung from Loei and Chiang Rai Provinces collected in the cold season. This fungus is the new record for Thailand.

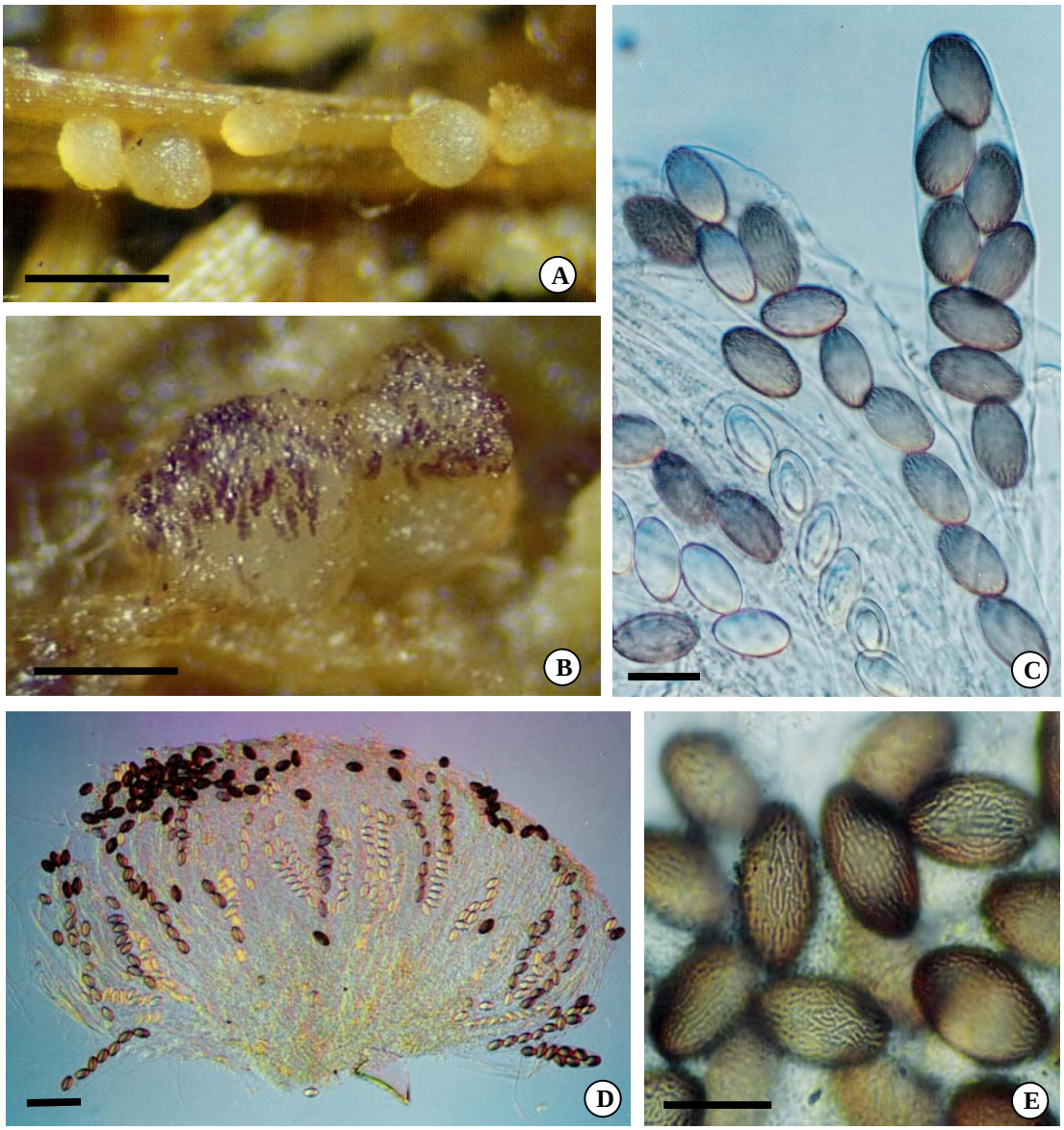


Figure 12 ***Ascobolus albidus*** Crouan. (KUFC 2452)

A, B. Apothecia on elephant dung; C. Asci and ascospores

D. Apothecium, asci and ascospores; E. Ascospores

(bars: A, B = 0.5 mm; C, E = 20 μm; D = 50 μm).

7. ***Ascodesmis macrospora*** W. Obrist, 1961 (Figures 13, 14)

Specimen examined: KPFC 2454, 2455 and 2456 (rat)

References: Obrist (1961), Richardson & Watling (1997)

Colonies on PDA growing rapidly, reaching 8-9 cm diam. in 7 days at 28 ^{o}C (Figure 13A). Mycelium whitish brown, white tuft of aerial hyphae, forming apothecia in 12-14 days. Apothecia minute, hemisphaerical to subglobose, soft-fleshed, 100-200 μm, first hyaline, becoming dark brown at maturity. Asci 8-spored, broadly clavate, oblong, elliptical or ovoid, 80-90 x 20-33 μm, opening by a slightly obliquely attached operculum, thin-walled (Figure 13B). Ascospores one-celled, broadly ellipsoid, 17-22 x 12-17 μm, first hyaline, then pale brown, becoming dark brown at maturity, ornamented with reticulum, spores discharged at once through opening of operculum (Figures 13C, 13D, 14).

Manoch *et al*. (1999) reported *Ascodesmis* sp. from toad dung which resembled *A. macrospora* in this study. This research confirmed the occurrence of *A. macrospora* isolated from toad dung using the alcohol treatment method (Manoch *et al*. 1999). In addition, Manoch *et al*. (1999) described *A. porcina* from soil using the alcohol treatment method.

Kirk *et al*. (2001) wrote that six species of *Ascodesmis* were recorded worldwide and all are coprophilous species. Richardson and Watling (1997) presented a key for 6 species of *Ascodesmis* from dung, including *A. macrospora*, *A. nana*, *A. sphaerospora*, *A. microscopica*, *A. porcina* and *A. nigricans*.

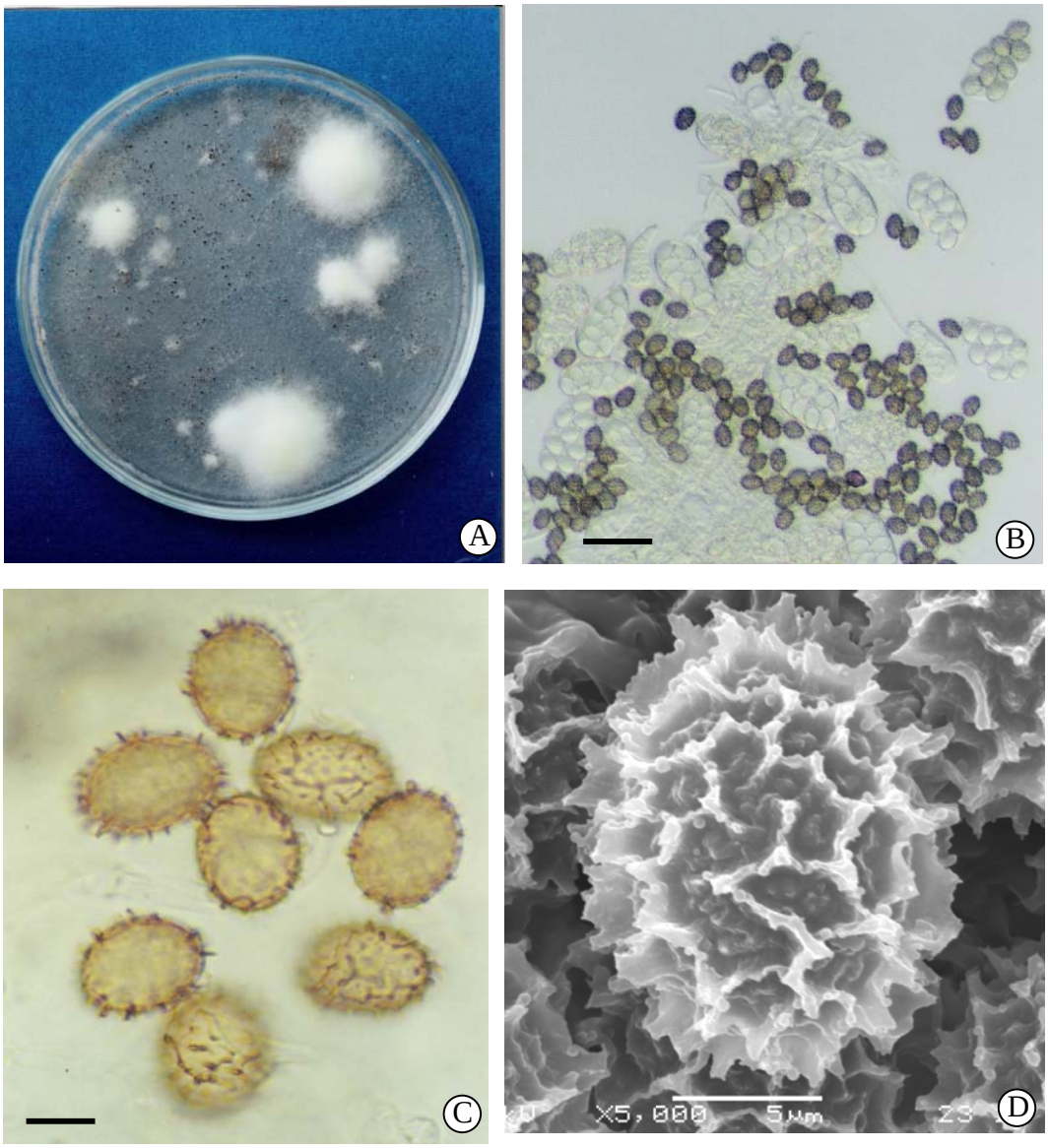


Figure 13 ***Ascodesmis macrospora*** Obrist. (KUFC 2454)

A. Colony on PDA, 14 days at 28 ^{o}C; B. Asci and ascospores

C. Ascospores; D. SEM photomicrograph of ascospores

(bars: B = 50 μm, C =10 μm, D = 5 μm).

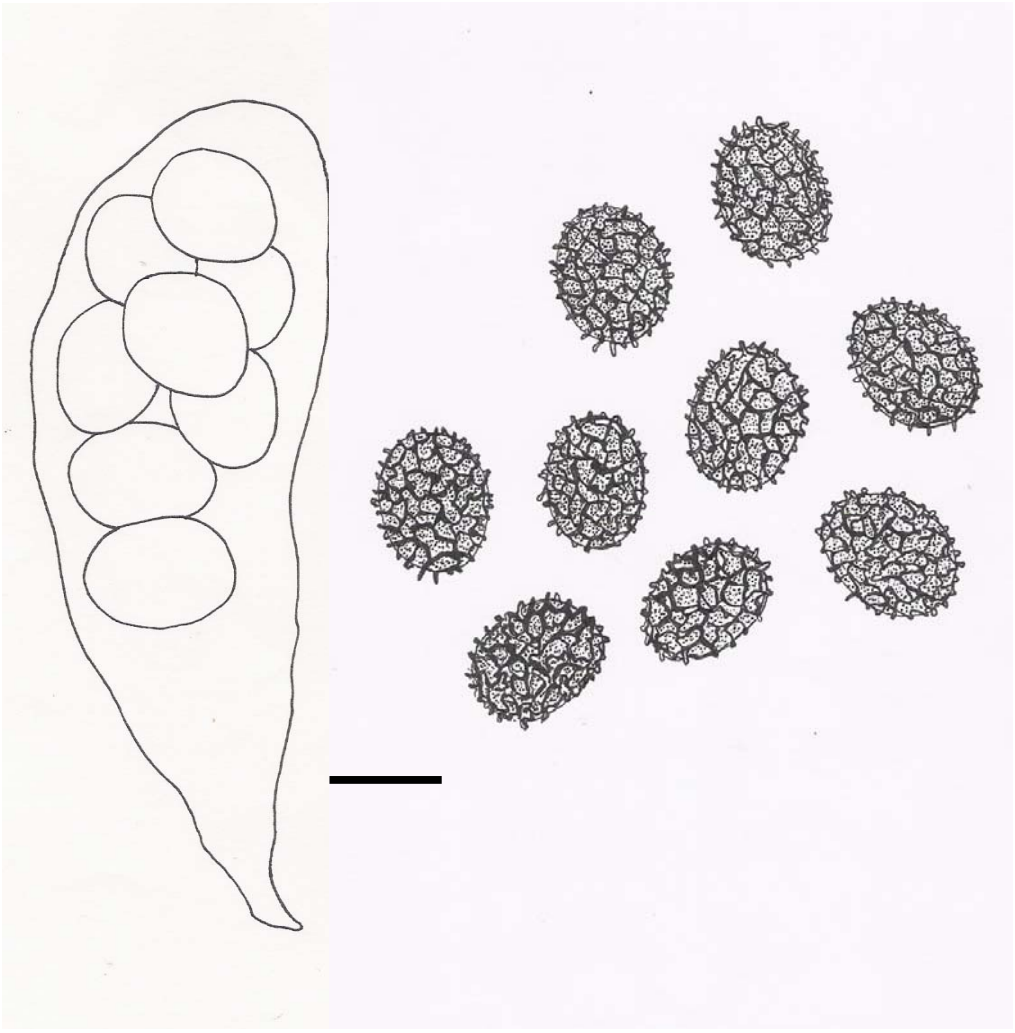


Figure 14 ***Ascodesmis macrospora*** Obrist. (KUFC 2454)

Camera lucida drawings of ascus and ascospores (bar = 10 μm).

8. ***Ascodesmis sphaerospora*** W. Obrist, 1961 (Figures 15, 16)

Specimen examined: KPFC 2457 (toad)

References: Obrist (1961), Richardson & Watling (1997)

Colonies on PDA growing rapidly, reaching 8-9 cm diam. in 7 days at 28 ^{o}C (Figure 15A). Mycelium brownish white, cottony, forming apothecia in 12-14 days. Apothecia subglobose, soft-fleshed, 80-200 μm, scattered or gregarious, hyaline, superficial, without excipulum, with many asci surrounded by paraphyses. Asci 8-spored, broadly clavate, oblong or ovoid, 50-80 x 25-30 μm, opening by a slightly obliquely attached operculum, thin-walled (Figure 15C, 16). Ascospores one-celled, spherical to ellipsoid, 10-11 x 10.5-11 μm, L/B ratio mostly < 1.2, first hyaline, then pale brown, becoming dark brown at maturity, ornamented with a dark brown reticulations and ridges (Figures 15B, 15D, 16).

A. sphaerospora was isolated from toad dung in Bangkok using the dilution plate method. This fungus is a new record in Thailand. Hein *et al*. (1998) reported *A. sphaerospora* from bison dung in Canada.This fungus produces arugosin F and xanthone which can inhibit *Bacillus subtilis* (ATCC 6051), *Staphylococcus aureus* (ATCC 29213) and the coprophilous fungi *Ascobolus furfuraceus* (NRRL 6460) and *Sordaria fimicola* (NRRL 6459) *in vitro*. *A. sphaerospora* is the new record for Thailand.

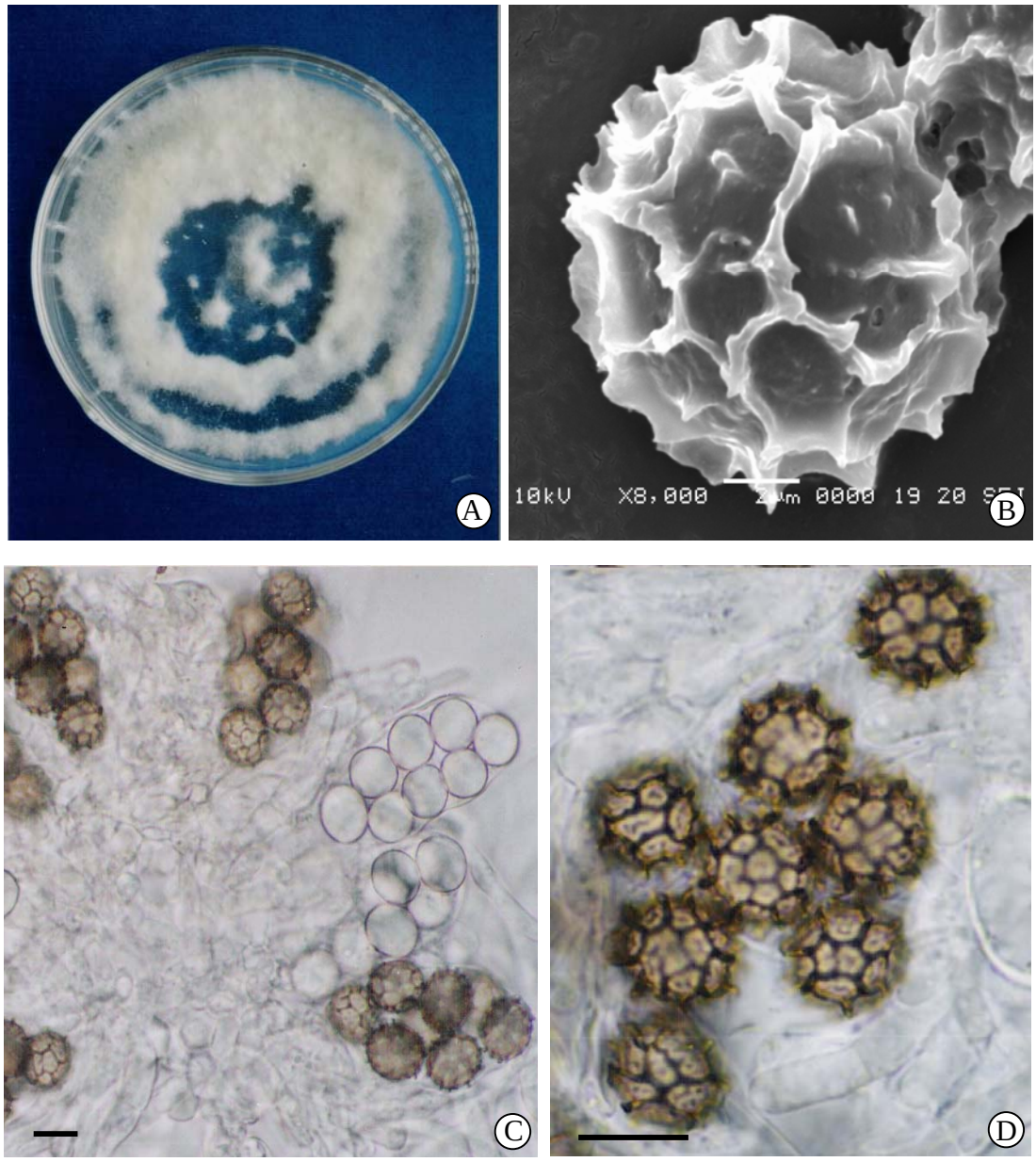


Figure 15 ***Ascodesmis sphaerospora*** Obrist. (KUFC 2457)

A. Colony on PDA, 14 days at 28 ^{o}C; B. SEM photomicrograph of ascospore; C, D. Asci and ascospores (bars: B = 2 μm; C, D = 10 μm).

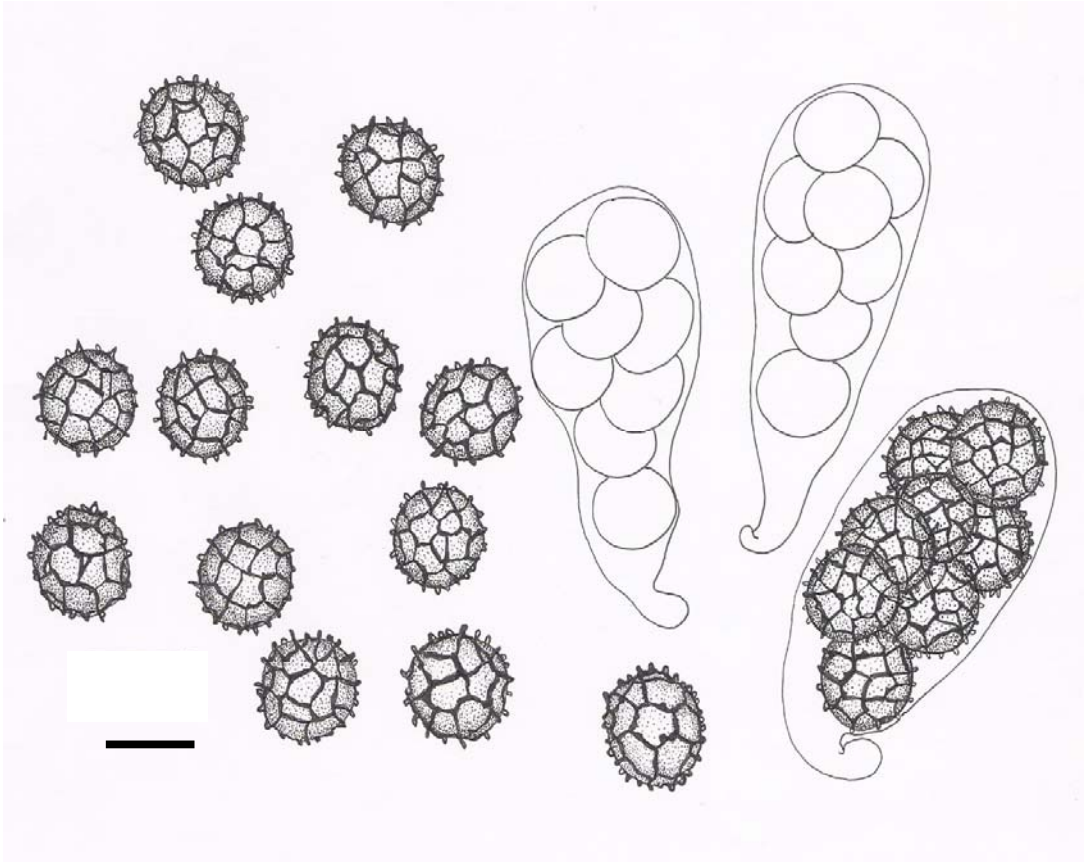


Figure 16 ***Ascodesmis sphaerospora*** Obrist. (KUFC 2457)

Camera lucida drawings of asci and ascospores (bar = 10 μm).

9. ***Aspergillus candidus*** Link, 1809

Specimen examined: KUFC 2897 (deer) and 2899 (rat)

Reference: Raper and Fennell (1965)

Colonies on Czapek's solution agar (CZA), reaching 2.5-3 cm diam. in 14 days at 28 ^{o}C. Mycelium white to cream, dense, reverse uncolored. Conidial heads radiate, stipes 200-500 x 4-10 μm, smooth walled to finely roughened, uncolored. Vesicles globose to subglobose, 20 -35 μm wide. Metulae colorless, 7-10 x 5-8 μm. Phialides 6-9 x 2-3 μm. Conidia subglobose, thin walled, smooth, colorless, 3-4 μm.

A. candidus is widely distributed in nature and commonly found from soil, grains, seeds, dung and various substrates (Raper and Fennell, 1965; Klich, 2002). This fungus is rarely isolated from soil in Thailand. However, five isolates of *A. candidus* were reported from deer, banteng, bird and chicken dung from Huay Khang Wild Life Sanctuary, Uthaithani province (Manoch *et al*., 1999).

10. ***Aspergillus clavatus*** Desm., 1834

Specimen examined: KUFC 2900 (cow); 2914 (deer); 2915, 2917, 2919, 2923 (rat) and 2926 (toad)

Reference: Raper and Fennell (1965)

Colonies on CZA, reaching 2.5-3 cm diam. in 7 days at 28 ^{o}C. Mycelium blue green. Conidial heads clavate, 300-400 μm, Conidiophores thin wall smooth, colorless, gradually enlarging at the apex into a clavate. Vesicles colorless, 200-250 x 40-50 μm, unisereate. Phialides 8-10 x 2-3 μm. Conidia smooth-walled, ellipsoidal, occasionally pyriform, apiculate or almost cylindrical, 3-4 x 2-3 μm.

Klich (2002) reported two mycotoxins, patulin and cytochalasin-E from *A. clavatus*.

11. *Aspergillus flavus* Link, 1809

Specimen examined: KUFC 2931 (barking deer); 2934, 2936, 2940, 2941, 2943 (buffalo); 2945 (camel); 2949, 2951, 2953, 2957, 2958, 2960, 2962, 2965 (cow); 2969, 2971, 2973 (deer); 2975, 2980, 2991, 2983 (elephant); 2985 (gaur); 2988 (goat); 2990 (horse); 2992 (rabbit); 2994, 2996 (rat) and 2998, 3000 (toad)

Reference: Raper and Fennell (1965)

Colonies on CZA, reaching 4-4.5 cm diam. in 7 day at 28 ^{o}C. Mycelium yellow-green. Conidial heads typically radiate, 400-500 μm, smaller heads occasionally up to 300 x 50 μm. Conidiophores, uncolored, coarsely roughened. Vesicles subglobose or globose. Metulae colorless, 6-10 x 4-5 μm. Phialides 6-12 x 3-5 μm. Conidia typically globose to subglobose, echinulate, 3.5-4 diam, sometime elliptical, 4.5-5 x 3.5-4 μm. Sclerotia globose to subglobose and gradually changing from white through dark red-brown.

A. flavus is worldwide in distribution. It is the most widely reported food-borne fungus, it also colonizes decaying vegetation, crop seeds and many other substrates in indoor and outdoor environment (Pitt and Hocking, 1997; Samson *et al*., 2001) It has been reported as the commonest species which is the most carcinogenic mould producing aflatoxin B_1 toxigenic to the male rats (Moss, 2002a).

12. *Aspergillus fumigatus* Fres., 1863

Specimen examined: KUFC 2908, 2921 (barking deer); 2922, 2924, 2927, 2930, 2933, 2935 (buffalo); 2939 (camel); 2925, 2928, 2932, 2938, 2944, 2950, 2954, 2956, 2961, 2963 (cow); 2968, 2970 (deer); 2972, 2974, 2977, 2979 (eld's deer); 2982, 2984, 2987, 2991, 2993, 2997, 2999, 2302 (elephant); 3003 (goat); 3005 (horse); 3008, 3010, 3013, 3016 (rat) and 3020, 3025, 3027 (toad)

Reference: Raper and Fennell (1965)

Colonies on CZA, reaching 4-4.5 cm in diam. in 7 days at 28 ^{o}C. Mycelium bluish green. Conidial heads columnar, compact. Conidiophores smooth, more or less green colored 200-300 μm in length by 5-8 μm in diam. Vesicles up to 20 to 30 μmin diam., unisereate. Phialides crowed, 6-8 x 2-3 μm. Conidia green in mass, echinulate, globose to subglobose, 2.5-3 diam. smooth to finely roughened or spinose.

A. fumigatus is a human and animal pathogen, responsible for systemic mycoses usually resulting from invasion of the lungs or respiratory tract. It was reported from a wide range of substrates in both indoor and outdoor environments including soil, plants, seeds, sludge, wood chips, compost, cotton and even penguin excreta (Klich, 2002).

13. *Aspergillus niger* Van Tiegh., 1867

Specimen examined: KUFC 2929, 2937, 2942, 2946, 2947 (buffalo); 2948 (camel); 2952, 2955, 2959, 2964, 2966, 2967 (cow); 2976, 2978, 2986, 2989 (deer); 2995 (eld's deer); 3004, 3006, 3009, 3011 (elephant); 3014

(gaur); 3017 (goat); 3022, 3024 (horse); 3028, 3030, 3031 (rabbit); 3035, 3037, 3039, 3040 (rat) and 3042, 3044, 3046, 3049, 3050 (toad)

Reference: Raper and Fennell (1965)

Colonies on CZA, reaching 3-3.5 cm diam. in 14 days at 28 ^{o}C. Mycelium black or deep brownish black. Conidial heads black, radiate or in age often splitting into two or more loose columns. Conidiophores variable, walls smooth, colorless or in brownish shades. Vesicles globose, biseriate. Metulae brownish, 20-30 x 5-6 μm. Phialides 7-8 x 3-3.5 μm. Conidia globose, irregularly roughened, 4-5 μm in diam.

This species is commonly isolated from soil, litter, rhizosphere, seed, dried fruit and nuts. It is one of the most commonly mycotoxigenic fungus which can produce ochratoxin A (Klich, 2002).

14. ***Aspergillus terreus*** Thom, 1918

Specimen examined: KUFC 3001 (barking deer); 3007, 3012, 3015, 3018 (buffalo); 3019, 3021 (camel); 3023, 3026, 3029, 3032 (cow); 3033 (deer); 3036, 3038 (elephant); 3041, 3043, 3045, 3047 (horse); 3051, 3054 (rabbit); 3057, 3059, 3060 (rat) and 3063, 3065, 3068 (toad)

Reference: Raper and Fennell (1965)

Colonies on CZA, reaching 3-3.5 cm diam. in 7 days at 28 ^{o}C. Mycelium cinnamon to orange-brown, velvety. Conidial heads compact columnar, smooth-walled. Conidiophores more or less flexuous, smooth-walled, colorless, 100-300 x 4-7 μm.. Vesicles, hemispherical, 12-20 μm in diam., biseriate. Metulae over the upper

half to three quarters of the vesicle, tightly packed, 5-7 x 2-3 μm. Phialides 5-7 x 1.5-2.5 μm. Conidia globose to slightly elliptical, smooth-walled, 1.5-2.5 μm in diam.

A. terreus is distributed worldwide in soils but is more abundant in tropical and subtropical regions, and more common in greater than expected numbers of reports from cultivated soils (Klich, 2000). This fungus was reported to produce numerous mycotoxins such as patulin, citrinin, citreoviridin and gliotoxin (Klich, 2002). It is common in stored crops and has been isolated from other foodstuffs and from indoor environments (Domsch *et al*., 1980; Samson *et al*., 2001).

15. *Cephaliophora irregularis* Thaxter, 1903 (Figure 17)

Specimen examined: KUFC 3034, 3048, 3052, 3055 (cow) and 3061, 3064, 3066, 3067 (goat)

References: Ellis (1971), Seifert *et al*. (1983)

Colonies on PDA, reaching 9 cm diam. in 7 days at 28 ^{o}C (Figure 17A). Mycelium yellow to pale brown. Conidiophores clavate, up to 100 μm long, 5-10 μm thick. Conidia pyriform or turbinate, colourless to pale brown 1- to 2- septate, 25-40 x 15-30 μm, protuberant hilum (Figures 17B, 17C).

Eill (1971) reported *C. irregularis* from cocoa beans, dung, wood, soil and other substrates from many country. This species was recorded on ass, mouse and monkey dung (Seifert *et al*., 1983). Manoch *et al.* (1999) recorded two isolates of *C. irregularis* on rabbit and toad dung from Huay Khang Wild Life Sanctuary, Uthaithani province, Thailand.

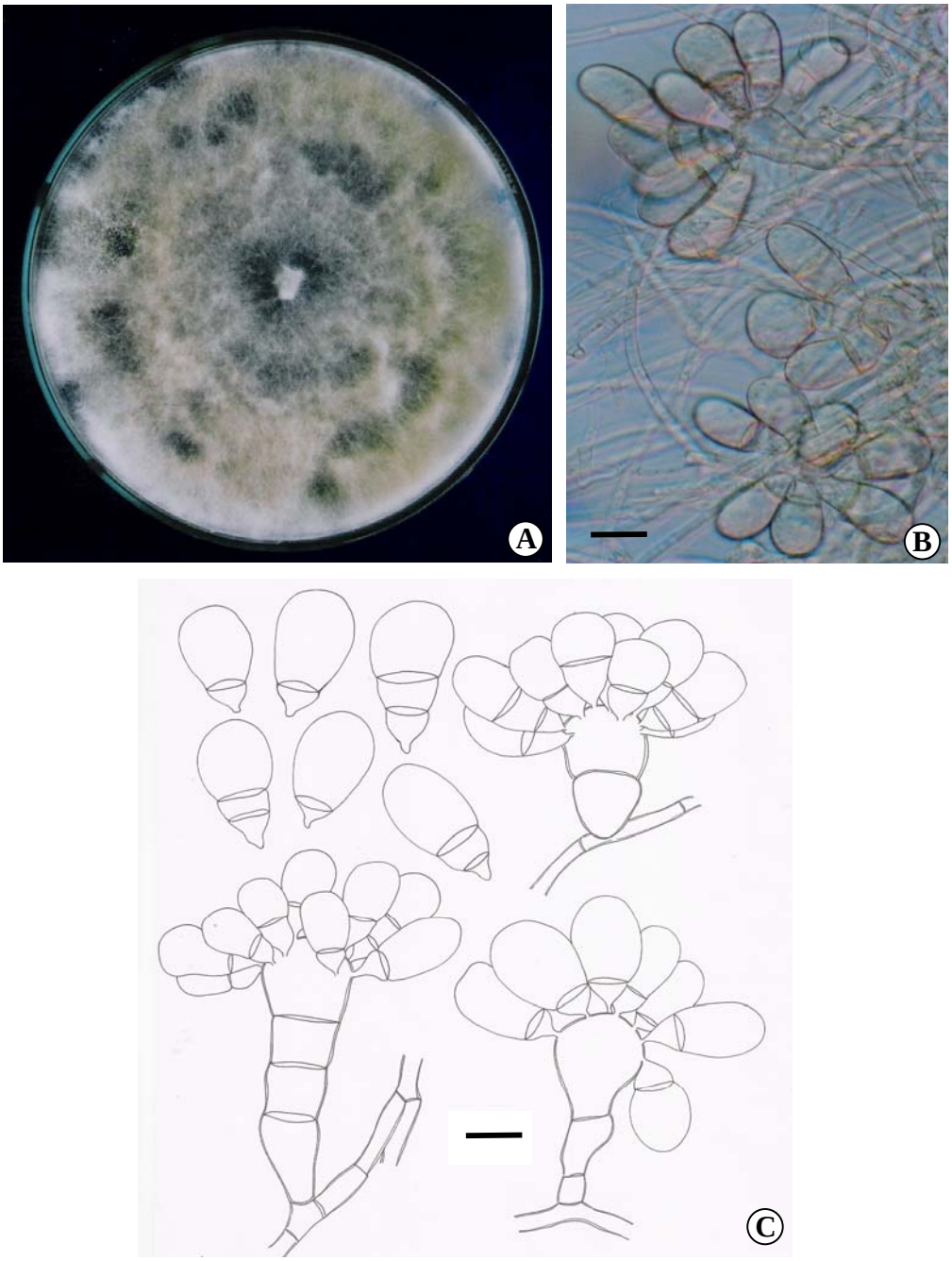


Figure 17 ***Cephaliophora irregularis*** Thaxter (KUFC 3034)
A. Colony on PDA, 7 days at 28 ^{o}C; B. Conidiophores and conidia
C. Camera lucida drawings of conidiophores and conidia
(bars: B = 20 μm; C = 10 μm).

16. *Cercophora silvatica* N. Lundq, 1972 (Figure 18)

Specimen examined: KUFC 2458, 2459 and 2460 (elephant)

References: Lundqvist (1972), Bell (1983), Ellis and Ellis (1998)

Colonies on PDA growing slowly, reaching 5-6 cm diam. in 14 days at 28 ^{o}C. Mycelium whitish to pale brown, forming perithecia in 10-14 days. Perithecia obpyriform, 500-530 x 300-400 μm, with protruding neck and tapered tufts of hair, immersed (Figures 18A, 18B). Asci 8-spored, cylindrical, 200-220 x 16-18 μm, subapical globules absent. Ascospores immature sigmoid, hyaline, 35-50 x 3-3.5 μm (Figure 18C); mature spores ellipsoid, dark brown, 15-16 x 7-9 μm; pedicel cylindrical, hyaline, 28-32 x 3-4 μm; the upper and basal cauda eccentrically attached.

Cercophora silvatica is found only on elephant dung from Chiang Mai, Northern Thailand and Krabi, Southern Thailand by the moist chamber method. This fungus was recorded from New Zealand (Bell, 1983), but was not found in Australia (Bell, 2005). In Thailand, Manoch *et al*. (1999) reported *C. coprophila* from cow and rabbit dung from Loei and Bangkok, respectively. *C. silvatica* is a new record for Thailand.

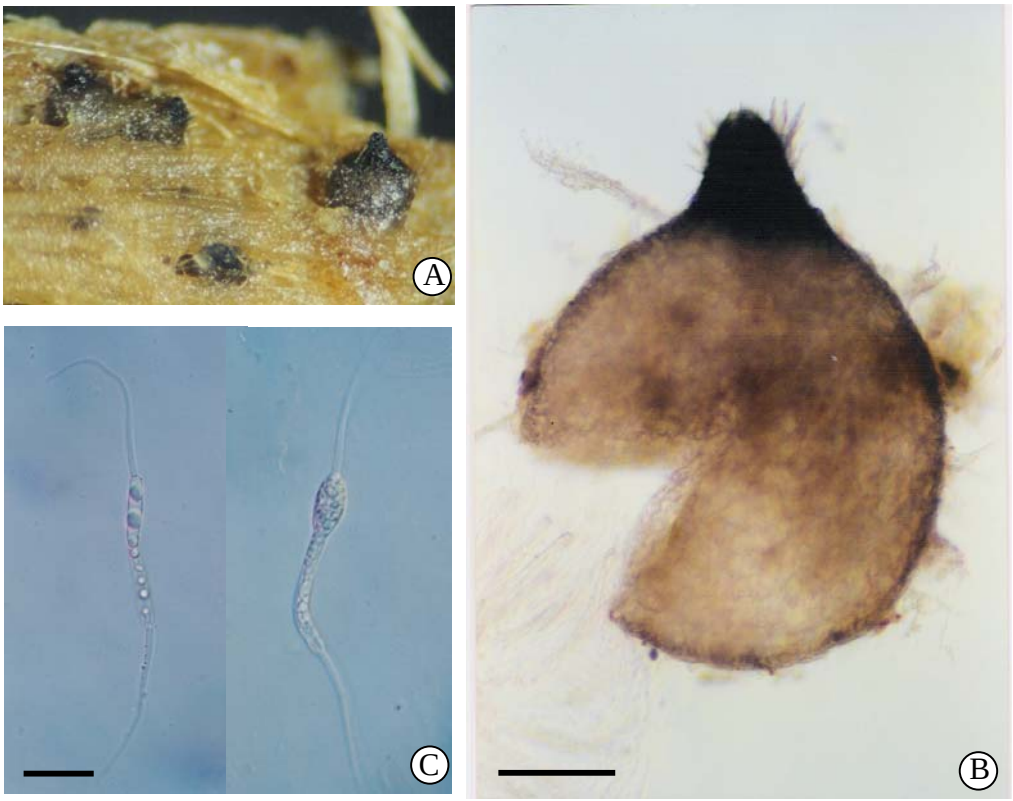


Figure 18 ***Cercophora silvatica*** Lundq. (KUFC 2458)

A. Perithecia on elephant dung; B. Perithecium; C. Sigmoid shaped of young and developing ascospores (bars: B = 100 μm; C = 10 μm).

17. *Chaetomella raphigera* Swift, 1930

Specimen examined: KUFC 2859 (buffalo); 2862, 2865 (cow) and 2867 (eld's deer)

Reference: Sutton (1980)

Colonies on PDA, reaching 9 cm in diam. in 14 days at 28 ^{o}C. Mycelium superficial or immersed, hyaline to pale brown, branched, septate. Conidiomata pycnidial 200-400 x 100-200 μm., separate, globose but opening widely, sessile or very shortly stipitate, dark brown to black but pale when young, Ostiole single, setae brown, smooth, thick-walled, septate, unbranched, clavate, often hooked at the apices. Conidia hyaline, aseptate, cymbiform to allantoid 4-5 x 1.8-2.3 μm.

Chaetomella raphigera were recorded from wide variety of substrates throughout the world but most commonly from soil (Sutton, 1980).

18. *Chaetomium crispatum* (Fuckel) Fuckel, 1870

Specimen examined: KUFC 2461 (elephant) and 2462, 2463 (cow)

Reference: Arx *et al*. (1986), Domsch *et al.* (1993), Ellis and Ellis (1998)

Colonies on PDA, reaching 9 cm diam. in 14 days at 28 ^{o}C. Mycelium whitish to yellow-green, forming perithecia in 7-10 days. Perithecia globose to subglobose, grey to grey-back, 300 x 200 μm; lateral hairs numerous, dark olive-brown; terminal hair olive-brown. Asci 8-spored, cylindrical, colourless. Ascospores lemon-shaped with broadly apiculate ends, 9-10 x 6.5-7 μm.

This species has been reported on dung of various animals, soil, dead flies and seed of various plants (Domsch *et al*., 1993).

19. *Chaetomium cupreum* Ames, 1969 (Figure 19)

Specimen examined: KUFC 2464 (cow); 2465 (deer); 2466 (elephant); 2467 (rabbit); 2468 (cow) and 2469 (eld's deer)

Reference: Ames (1969), Arx *et al*. (1986)

Colonies on PDA growing slowly, reaching 9 cm diam. in 14 days at 28 ^{o}C (Figure 19A). Mycelium whitish to grey, reverse red to brown, forming perithecia in 5-7 days. Perithecia globose to subglobose, golden red-brown, 270-300 x 180-220 μm; terminal hairs wavy or very loosely coiled, dark-brown with tips (Figures 19B, 19C, 19E). Asci 8-spored, short clavate, colourless (Figure 19D). Ascospores one-celled, lemon-shaped, two apical germ-pores, 8-10 x 6.5-8 μm (Figure 19F).

20. *Chaetomium globosum* Kunze ex Steud., 1824

Specimen examined: KUFC 2470, 2471, 2472 (deer); 2473 (barking deer); 2474, 2475, 2476, 2477, 2479 (rabbit); 2478 (gaur); 2480, 2481(goat); 2482 (horse); 2483, 2484, 2485, 2486 (cow); 2487 (camel) and 2488 (eld's deer)

References: Arx *et al*. (1986), Domsch *et al.* (1993), Ellis and Ellis (1998)

Colonies on PDA growing rapidly, reaching 9 cm diam. in 7 days at 28 ^{o}C. Mycelium dense, olivaceous, grey layer of ascomata, forming a grey layer of perithecia in 5-7 days. Perithecia globose to subglobose, dark brown, 200-300 x 200-250 μm; terminal hairs wavy or very loosy coiled, dark olive-brown with tips. Asci 8-

spored, short clavate, colourless. Ascospores one-celled, lemon-shaped, greenish, 8-12 x 6.5-8 μm, with two apical germ pores.

Chaetomium species are of worldwide distribution in temperate and tropical regions and they are mainly found on soil and fresh droppings of horse, squirrel, goat, rabbit and antelope (Domsch *et al*., 1993) and dung of various animals in New Zealand and Australia (Bell 1983, 2005). *C. globosum* was reported as the biological control agent against some plant pathogenic fungi such as rice blast (Soytong, 2004) and spot blotch of wheat (Selvakumar *et al*., 2002). *C.cupreum* and *C. globosum* were also reported to produce many secondary metabolites and mycotoxins (Kanokmedhakul *et al*., 2002; 2004).

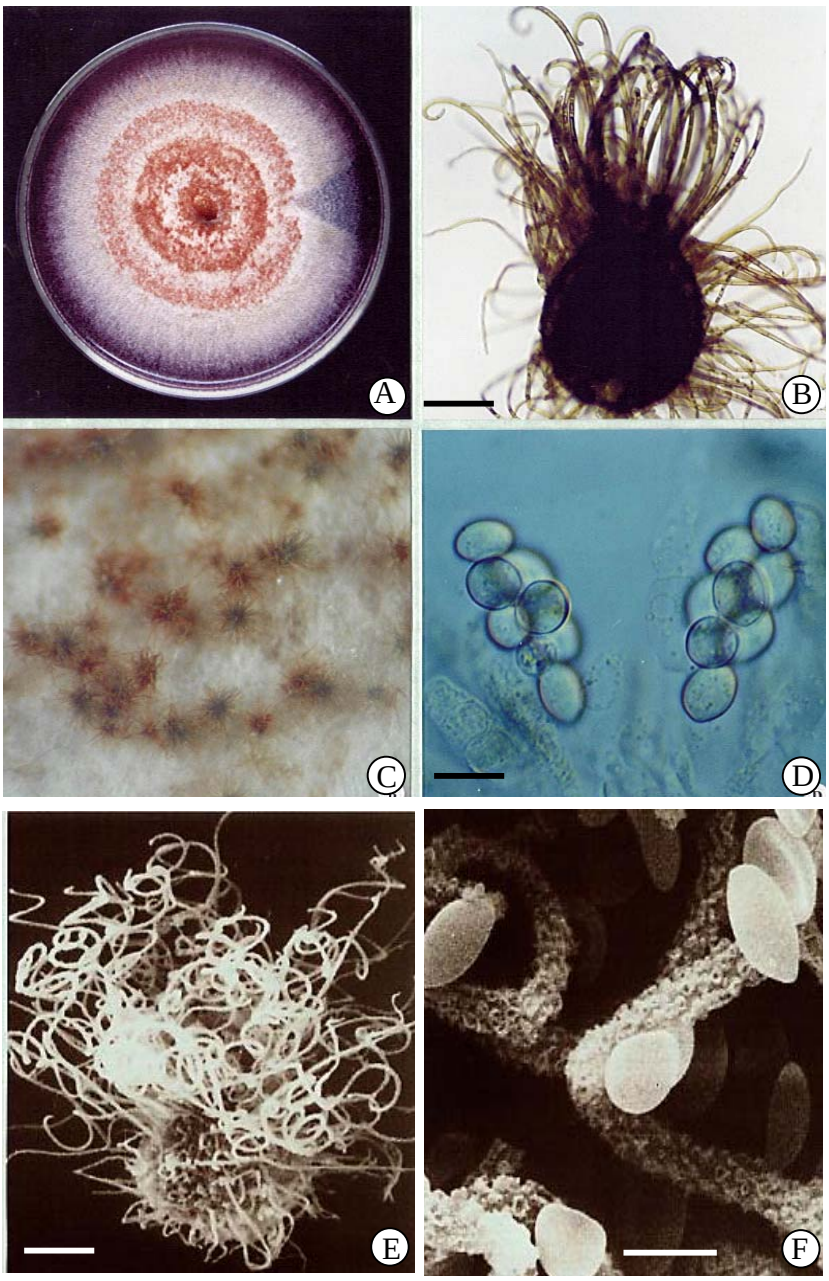


Figure 19 ***Chaetomium cupreum*** Ames (KUFC 2470)

A. Colony on PDA, 14 days at 28 ^{o}C; B, C. Perithecium; D. Asci and ascospores; E, F. SEM photomicrographs of perithecium with spiral hair and ascospores (bars: B, E = 100 μm; D, F = 10 μm).

21. *Choanephora cucurbitarum* (Berk. & Ravenel) Thaxt., 1903

Specimen examined: KUFC 2719 (gaur)

Reference: Domsch *et al*. (1993)

Colonies on PDA growing rapidly, reaching 9 cm diam. in 7 days at 28 ^{o}C. Mycelium white to cream. Sporangia globose, 150-200 μm in diam. Sporangiophores 20-24 μm long, Collumella obovoid or pyriform. Sporangiospores ellipsoidal, longitudinal striate, 10-14 x 5-7 μm, with hyaline appendage.

22. *Cladosporium cladosporioides* (Fres.) de Vries, 1952

Specimen examined: KUFC 3053, 3056, 3058, 3062 (barking deer); 3071, 3073, 3075, 3080, 3081, 3084, 3085 (cow); 3090, 3092, 3095 (elephant)

References: Ellis (1971), Domsch *et al*. (1993)

Colonies on PDA, reaching 5 cm in diam. in 7 days at 28 ^{o}C. Mycelium effuse, olive green, velvety, reverse olivaceous-black. Conidiophores up to 200-250 μm long, 2-6 μm thick, Conidia formed in long branched chains, mostly 0-1 septate, ellipsoidal to lemon-shaped, smooth-walled, olivaceous-brown, 1-celled, 4-8 x 2-4 μm.

Ellis (1971) reported *C. cladosporioides* as a secondary invader on many different plants and was found from air, soil, textiles, etc. Seifert *et al*. (1983) recorded *C. cladosporioides* from horse dung.

23. *Colletotrichum gloeosporioides* (Penz.) Sacc., 1882

Specimen examined: KUFC 2863 (barking deer); 2866, 2870 (buffalo); 2875, 2878, 2880 (cow); 2882 (eld's deer); 2884 (goat) and 2886 (horse)

Reference: Sutton (1980)

Colonies on PDA, reaching cm in diam. in 7 days at 28 ^{o}C. Mycelium olivaceous green, velvety, reverse olivaceous-black. Conidiophores bearing numerous conidial chains. Conidia are straight, obtuse at the apex, 8.5-24.5 x 3.0-4.25 μm and appressoria are 6-24 x 4-12 μm clavate or irregular, sometimes becoming complex.

Sutton (1980) reported *C. gloeosporioides* on berries of coffea Arabica from Kenya, Tanzania and Ethiopia.

24. *Cuninghamella elegans* Lendner, 1907

Specimen examined: KUFC 2715, 2716 (buffalo); 2715, 2724, 2727, 2730 (cow); 2732 (elepahnt); 2734, 2738 (goat) and 2745 (rat)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 6.0 cm in diam. in 7 days at 28 ^{o}C. Mycelium olivaceous green, velvety, reverse olivaceous-black. Sporangiophores to 18.5 μm wide, with verticillate or solitary branches vesicles subglobose to pyriform, the terminal ones to 40 μm and the leteral ones 15-30 μm diam. Sporangioles globose and 5.5-10.0 μm diam, or ellipsoidal and 9-12.0 x 5.0-10.0 μm, smooth, verrucose or short-echinulate, hyaline singly but brownish in mass. Zygospores globose, brownish, with rather flat, tuberculate projections.

25. ***Curvularia lunata*** (Wakker) Boedijn, 1933

Specimen examined: KUFC 3069, 3070 (cow); 3072 (eld's deer); 3074 (goat) and 3078 (rat)

Reference: Ellis (1971)

Colonies on PDA, reaching 7 cm diam. in 7 days at 28 ^{o}C. Mycelium brow, to black, cottony or velvety. Conidiophores often geniculate, brown. Conidiogenous cells terminal, sympodial, cylindrical. Conidia solitary, simple, often curved, clavate, obovoid or pyriform with 3 transverse septa, pale or dark brown, 20-30 x 10-14 μm.

This species is the anamorph state of *Cochliobolus lunatus* Nelson, it was commonly reported found on corn leaf spot and many other substrata (Ellis, 1971, Manoch *et al*., 2001).

26. ***Emericella nidulans*** (Eidam) Vuill., 1927

Specimen examined: KUFC 2714 (cow); 2720 (eld's deer); 2726 (gaur) 2728 (goat)

References: Domsch, *et al*. (1993); Raper and Fennell (1965)

Colonies on PDA, reaching 5-6 cm in diam in 7 day at 28 ^{o}C, brow to redish brown. Conidiophores smooth-walled, pigmented, with a hemispherical vesicle; conidial heads columnar; conidia globose verrucose. Cleistothecia mostly 100-250 μm diam, white at frist but at maturity dark red, surrounded by heavy walled hülle cells 15-25 μm diam. Ascospores red to purple, ellipsoidal, 4-6 μm long, smooth walled, usually ornamented with two conspicuous longitudinal flanges.

E. nidulans has been isolated from a wide variety of sources. Cereals and cereal products have been the most common, including wheat, rice, maize and sorghum. Other sources include peanuts, hazelnuts, meat, soybeans, pepper corns, chocolate (Pitt and Hocking, 1997).

27. *Emericella rugulosa* Thom & Raper C.R. Benjamin, 1955 (Figure 20)

Specimen examined: KUFC 2489 (rat) and 2490 (cow)

Reference: Raper and Fennell (1965)

Colonies on PDA growing slowly, reaching 2-2.5 cm diam. in 10-14 days at 28 ^{o}C. Mycelium with sparse green conidial heads. Abundant purple-brown cleistothecia formed in 5-7 days, globose to subglobose, red brown, 200 x 370 μm, surrounded by globose, colourless, hülle cells. Asci 8-spored, globose to subglobose, colourless. Ascospores lenticular, rugulose, with two sinuate equatorial crests, purple-red, 4.0-4.5 μm diam x 3.0-3.5 thick (Figures 20B, 20C, 20D).

Anamorph-*Aspergillus rugulosus* Thom & Raper, Mycologia 31: 660-663. Conidiophores smooth-walled, pale brownish, 40-80 μm long. Conidial head columnar. Conidia globose, rugulose, 3.5-4 μm (Figure 20A).

Emericella. *rugulosa* is a common soil fungi and was reported from several place in the USA; the type strain was isolated from New Jersey soil (Raper and Fennell 1965). Other habitats include forest nurseries, alkaline soils, mangrove mud and rhizosphere of various cultivated plants (Domsch *et al.*, 1993).

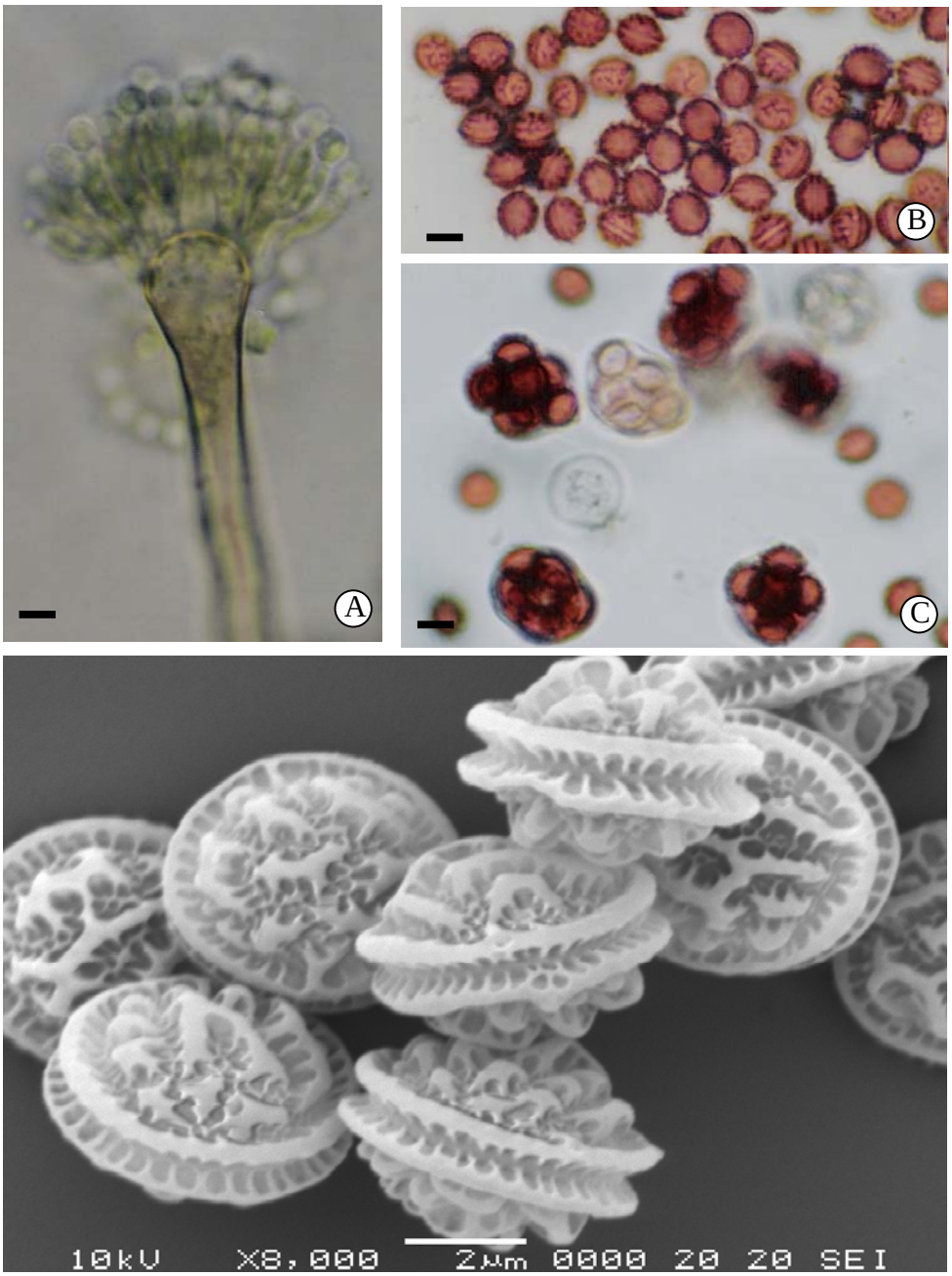


Figure 20 ***Emericella rugulosa*** Thom & Raper C.R. Benjamin (KUFC 2489) A. Conidiophore with conidia; B. Ascospores; C. Hülle cell, asci and ascospores; D. Scanning electron photomicrograph of ascospores (bars: A, B, C = 4 µm; D = 2 µm).

28. *Emericella variecolor* Berk. & Broome, 1857

Specimen examined: KUFC 2735,2744 (cow); 2746 (rat) and 2758 (toad)

Reference: Raper and Fennell (1965)

Colonies on CZA growing slowly, reaching 2.5-3.5 cm diam. in 10-14 days at 28 ^{o}C. Mycelium with few green conidial heads and abundant purple-brown ascomata formed in several layers. Cleistothecia 220-325 μm diam, surrounded by dark brow, globose hulle cells ascospores piuple-red, lenticular, rugulose, with two sinuate equatorial crests, the bodies measuring 4.0-4.4 μm diam. Conidiophores smooth-walled, pale brownish, 50-80 μm long; conidial heads columnar; conidia globose, rugulose, 3-4 μm diam.

29. *Eupenicillium parvum* (Raper & Fennell) Stolk & D.B. Scott, 1967

Specimen examined: KUFC 2736 (buffalo); 2752 (camel); 2755, 2757, 2760, 2762 (cow); 2770 (deer); 2773, 2776, 2779 (elephant); 2781 (goat); 2783 (horse); 2786, 2789 (rat); 2791, 2793 (toad)

Reference: Pitt (1979)

Colonies on MEA growing slowly, reaching 2-2.5 cm diam. in 10-14 days at 28 ^{o}C. Mycelium white, appearing red brown due to exudate. Cleistothecia abundant, submerged in the mycelium, 70-100 μm. Asci borne singly, ellipsoidal, 6-7 μm in long axis. Ascospores ellipsoidal, very small, 2-2.5 x 1.5-2.0 μm, with roughened or spinose walls and two widely spaced longitudinal flanges. Conidiophores smooth walled, monoverticillate, 20-30 x 1.2-1.5 μm. Conidia spheroidal, smoot walled, 1.5-2 μm.

30. *Eurotium amsterodami* Mangin, 1908

Specimen examined: KUFC 2764 (barking deer); 2766 (buffalo); 2768, 2771, 2774, 2775 (cow); 2778, 2780 (elephant); 2782 (gaur); 2784, 2787 (horse); 2790 (rabbit); 2792 (rat) and 2795, 2797 (toad)

Reference: Domsch *et al*. (1993)

Colonies on CZA reaching 2.5-3.0 cm diam. in 10-14 days at 28 ^{o}C. Mycelium yellow to dull yellow-grey. Conidial heads deep olive-green. Ascospores with irregularly papillate valves and broad ridges, 4.7-5.0 X 3.6-3.8 μm Conidia subglobose to ellipsoidal, with end commonly flattened, finely papillate, mostly 4.5-5.0 X 3.5-4.0 μm, uninucleate.

31. *Exserohilum rostratum* (Drechsler) Leonard and Suggs, 1974

Specimen examined: KUFC 3079 and 3082 (elephant)

Reference: Sivanesan, 1987

Colonies on PDA, reaching 8-9 cm diam. in 7 days at 28 ^{o}C. Mycelium brown or black, cottony or velvety. Conidiophores 200-320 μm long, 6-7 μm thick, septate, cylindrical, olivaceous brown, paler towards the apex, simple, geniculate. Conidia straight to slightly curved, ellipsoidal to narrowly obclavate, brown or olivaceous, thick-walled, 15-220 x 10-27 μm.

Exserohilum rostratum was recorded as the pathogen causing nasal phaeohyphomycosis, keratitis, subcutaneous and invasive infections in human and several animal infections (de Hoog *et al.*, 2000). However, Chandramohan and Charudattan (2001) studied the biological control of seven grasses using a mixture of

Drechslera gigantea, *Exserohilum longirostratum* and *E. rostratum*, isolated from large crabgrass (*Digitaria sanguinalis*), crowfootgrass (*Dactyloctenium aegyptium*) and Johnsongrass (*Sorghum halepense*), respectively in Florida. The results indicated that all seven grasses including crowfootgrass, guineagrass, Johnsongrass, large crabgrass, southern sandbur, Texas panicum and yellow foxtail were susceptible to each of the pathogens and the pathogen mixture.

32. *Fusarium oxysporum* Schlecht, 1824

Specimen examined: KUFC 3076, 3077 (barking deer); 3083, 3086 (buffalo); 3087 (camel); 3088, 3091, 3094, 3093, 3101, 3103, 3105, 3108, 3110, 3111 (cow); 3114, 3115 (deer); 3120, 3123, 3124, 3126 (elephant); 3128 (horse) and 3130 (toad)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 4.5-6.5 cm diam. in 7 days at 28 ^{o}C. Mycelium white or peach, but usually with a purple or violet tinge. Sporodochia with an orange slime of macro-conidia. Microconidia generally abundant, simple, lateral phialides, never forming chains, mostly 0-septate, ellipsoildal to cylindrical, 5-10 x 2-3.5 μm. Macroconidia fusiform, moderately curved, 3-5 septate, 25-47 x 3.0-4.5 μm. Chlamydospores terminal and intercalary in hyphae, smooth-walled, 5-15 μm diam.

Fusarium oxysporum has a worldwide distribution, mostly as a soil saprophyte and on numerous host plants in which specialized pathotypes may cause vascular wilt or damping-off (Domsch *et al*., 1993). Samson *et al.* (2002) reported secondary metabolites from *F. oxysporum*, such as fusaric acid, moniliformin, naphthoquinone pigment and nectriafurone.

33. ***Fusarium solani*** (Mart.) Sacc., 1881

Specimen examined: KUFC 3100 (buffalo); 3102, 3104, 3106, 3107, 3116, 3119, 3121, 3125 (cow); 3131, 3132, 3137 (deer); 3140, 3145, 3149, 3150 (eld's deer); 3153, 3156, 3157, 3159, 3160, 3164, 3167 (elephant); 3169 (gaur); 3171 (goat); 3173 (rabbit)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 3.2 cm diam. in 7 days at 28 ^{o}C. Mycelium cream to buff. Microconidia useually abundant, produced on elongate, 10-15 x 2-4 μm. Macroconidia fusiform, moderately curved, blunt apical and basal cells pedicellate, 3-5 septate, 27-46 x 3.0-4.5 μm. Chlamydospores terminal and intercalary in hyphae, 7-18 μm diam.

This species was isolated from forest and agricultural soil and was found as the specialized pathogens of particular host plants (Domsch *et al*., 1993). *F. solani* produces mycotoxin, fusaric acid and naphthoquinone pigments (Samson *et al.*, 2002).

34. ***Gelasinospora brevispora*** R.S. Khan and J.C. Krug, 1989 (Figures 21, 22)

Specimen examined: KUFC 2491 (cow)

Reference: Khan and Krug (1989)

Colonies on PDA growing slowly, reaching 9 cm diam. in 14 days at 28 ^{o}C (Figure 21A). Mycelium brown to dark brown, forming perithecia in 7-10 days. Perithecia scattered, immersed, globose to subglobose, brown to dark brown, ostiolate, 300-500 x 200-400 μm. Asci 8-spored, cylindrical, colourless, 140-200 x 18-30 μm.

Ascospores one-celled, subglobose to ellipsoidal, hyaline when young, becoming olivaceous brown to dark brown, with walls uniformly ornamented with numerous, uniformly round or ovate depressions (or pits), provided with a circular germ pore at each end, 26.5-28 x 18-20 μm (Figures 21B, 21C, 21D, 22).

Khan & Krug (1989) described *Gelasinospora brevispora* as a new species on cow, zebra and herbivore dung from Kenya, cow dung from Lotype, cow and elephant dung from Tanzania. In this study, we could found only one isolate of *G. brevispora* from cow dung collected from Goad Island, Trat Province, Eastern Thailand. This fungus is a new record for Thailand.

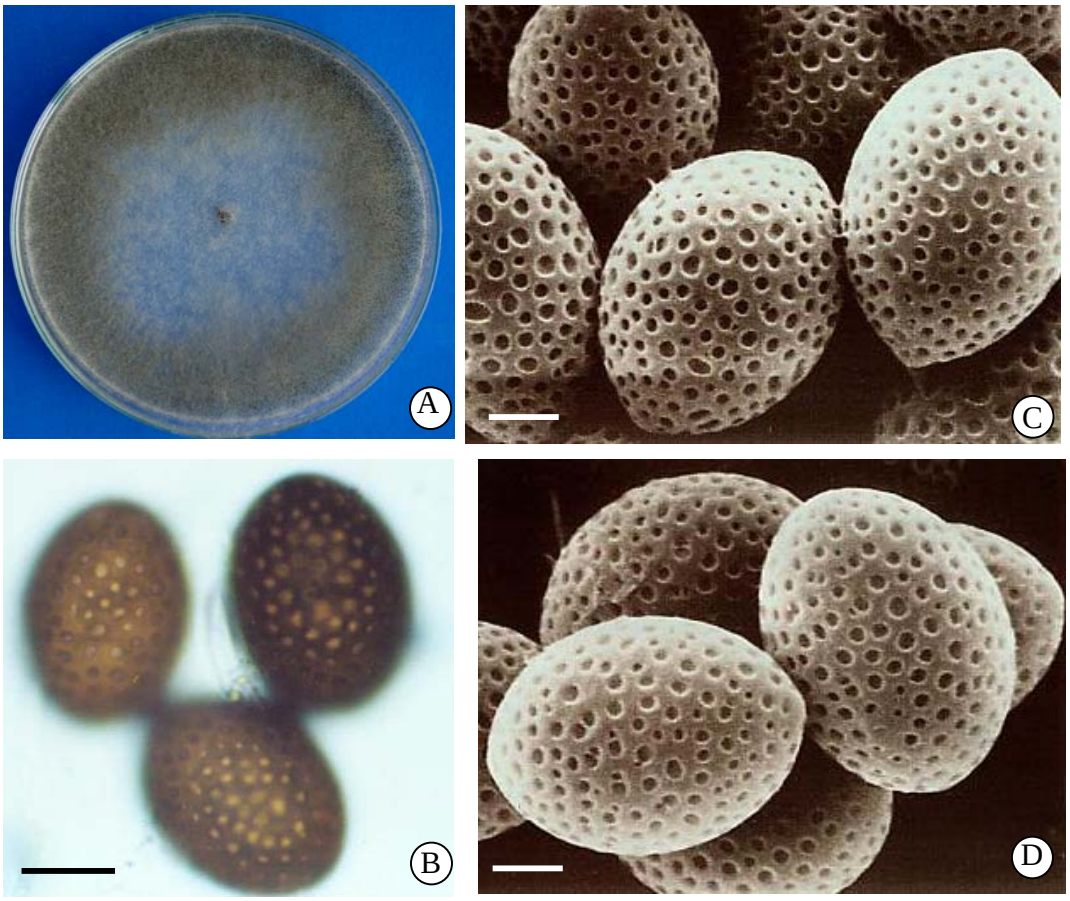


Figure 21 ***Gelasinospora brevispora*** Khan & Krug (KUFC 2491)
A. Colony on PDA, 14 days at 28 °C; B. Light photomicrograph of ascospores; C-D. SEM photomicrographs of ascospores (bars: B = 10 μm; C, D = 5 μm).

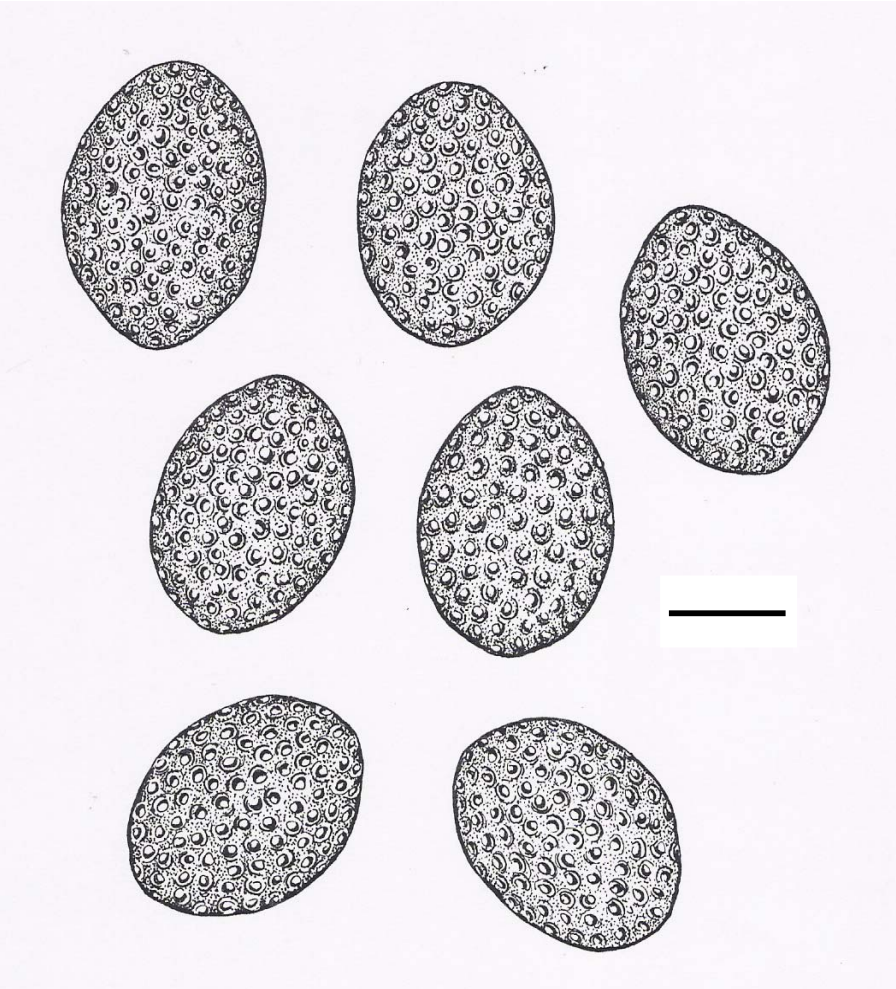


Figure 22 ***Gelasinospora brevispora*** Khan & Krug (KUFC 2491)

Camela lucida drawings of ascospores (bar = 10 μm).

35. ***Hamigera avellanea*** Stolk & Samson, 1971

Specimen examined: KUFC 2769, 2772 (cow); 2785 (elephant) and (goat)

Colonies on MEA reaching 4.5-5 cm in diam. in 7 days at 28 ^{o}C. Mycelium grey to redish brown, reverse dark redish brown. Gymnothecia cream, about 120-180 μm diam. Asci ellipsoidal, hyaline, borne singly from fertile hyphae. Ascospores ellipsoidal 6.6-7 x 4.5-5.2 μm.

36. ***Lasiodiplodia theobromae*** (Pat.) Griff. and Maubl, 1909

Specimen examined: KUFC 2864 (barking deer) 2868 (buffalo) and 2871 (rabbit)

Reference: Sutton (1980)

Colonies on PDA growing slowly, reaching 9 cm diam. in 7 days at 28 ^{o}C. Mycelium black, cottony. Conidiomata up to 5 (2-4) mm diam. Conidiogenous cell 5-15 X 3 μm. Conidia maturing slowly, for some while hyaline and thin-walled, then thick –walled, family developing a median septum, dark brown pigmentation and longitudinal striations, 20-30 X 10-15 μm Paraphyses up to 50 μm long.

37. ***Memnoniella echinata*** (Riv.) Galloway, 1933 (Figure 23)

Specimen examined: KUFC 3089 (cow) 3093 (horse)

Reference: Ellis (1971)

Colonies on PDA, reaching 2-2.5 cm diam. in 14 days at 28 ^{o}C. (Figure 23A). Mycelium pale yellow with dark spot of conidia. Conidiophores 50-80 x 3-5

μm, gray, often covered in part with dark granules. Phialides mostly in groups of 5-8 x 3-5 μm. Conidia sphaerical of flattened dorsiventrally, 3-4 μm diam (Figure 23B).

M. echinata was common on dead plants, paper, textiles and soil (Ellis, 1971). Seifert *et al*. (1983) reported *M. echinata* from cow and rabbit dung. This species was reported to produce griseofulvins and the profiles of toxic compounds (Samson *et al*., 2002).

Figure 23 ***Memnoniella echinata*** (Riv.) Galloway (KUFC 3089)
A. Colony on PDA, 7 days at 28 ^{o}C and B. Conidiophores, phialides and conidia (bar = 10 μm).

38. *Mucor* sp. Mich. Ex St.-Am., 1821

Specimen examined: KUFC 2740 (cow)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 7 cm diam. in 7 days at 28 ^{o}C. Mycelium white to yellow and later often becoming dark grey with the development of the sporangia. Sporangiophore forming a dense mat, erect, without basal rhizoids, branched, bearing terminal many-spored sporangia without apophyses, with a large columella, hyaline, greyish or brownish, smooth walled, globose to ellipsoidal. Zygospores produced in the aerial mycelium between compatible mating types, dark brown.

39. *Myrothecium verrucaria* (Alb. and Schw.) Ditm.ex Fr., 1829

Specimen examined: KUFC 3112, 3113 (barking deer); 3122, 3127, 3129 (buffalo); 3133, 3135, 3138, 3141, 3143 (cow); 3146, 3147 (elephant); 3151 (goat) and 3154 (horse)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 7 cm diam. in 14 days at 28 ^{o}C. Mycelium white to cream, forming diffuse or coalescent olivaceous to black sporodochia. Phialides 3-6 in a whorl, 12-15 x 1.5-2 μm. Conidia broadly ellipsoidal, the apical end pointed and the basal truncate, bearing an apical, distinctly coloured, 6-10 x 2-4.5 μm.

Myrothecium verrucaria can produce cytotoxin in culture filtrates causing death in both sheep and calves where the symptoms are similar to culture those observed in lambs fed with roridin A and verrucarin A. The fungus is highly sensitive to γ-irradiation (Domsch *et al*, 1993). Isaka *et al.* (1999) reported the antimalarial

activity of macrocyclic trichothecenes from *M. verrucaria* BCC 112 isolated from soil in Kanchanaburi province, Thailand.

40. ***Neosartorya fischeri*** (Wehmer) Malloch & Cain, 1973

Specimen examined: KUFC 2794, 2796 (buffalo); 2799, 2701, 2805, 2807 (eld's deer); 2809, 2810, 2811, 2813 (cow); 2815, 2816, 2820, 2821 (deer); 2824, 2826 (elephant); 2830, 2831 (gaur); 2836 (goat); 2838, 2840 (rat) and 2841 (toad)

Reference: Domsch *et al*. (1993)

Colony on MEA reaching 5-6 cm diam. in 14 days at 28 ^{o}C. Mycelium white to creamish; reverse uncoloured to creamish. Cleistothecia globose, 80-150 (250) μm. Asci 8 spored, globose to somewhat flattened, 8-10 x 10-12 μm. Ascospores biconvex, colourless 6-7 x 4-4.5 μm., with two equatorial crests and irregular surface ridge.

41. ***Nigrospora oryzae*** (Berk. and Br.)Petch, 1924

Specimen examined: KUFC 3096 (cow)

Reference: Ellis (1971)

Colonies on PDA, reaching 6-7 cm diam. in 7 days at 28 ^{o}C. Mycelium at first white, later brown when sporulation is abundant. Conidiophores branched, flexuous, colourless to brown, smooth. Conidiogenous cells monoblastic, ampulliform, colourless, 3-5 μm in diam. Conidia silitary, spherical or broadly ellipsoidal, black, shining, smooth, 0- septate, 10-12.5 μm in diam.

Tanaka *et al*. (1997) reported nigrosporins A and B from *Nigrospora oryzae*. These compounds are the new phytotoxic and antibacterial metabolite. Okane *et al*. (1997) reported *N. oryzae* as endophyte fungus on leaves of various plants.

42. *Nodulisporium gregarium* (Berk. and Curt) Meyer, 1965

Specimen examined: KUFC 3098 (cow)

Reference: Ellis, 1971

Colonies on PDA, reaching 6 cm diam. in 7 days at 28 ^{o}C. Mycelium effuse, grey, brown, often velvety. Conidiophores often synnematous, up to 2 mm. high, individual threads pale to mid brown or olivaceous brown, verrucose, much branched towards the apex. Conidiogenous cells 10-18 x 2.5-3 μm. Conidia 4.5-6.5 x 2-3 μm.

This species was common on dead wood in the tropic (Ellis, 1971). Seifert *et al*. (1983) found *Nodulisporium* sp. on cow dung. *Nodulisporium* is the anamorph state of *Biscogniauxia* Kuntze (Hanlin, 1998).

43. *Oidiodendron griseum* Robak, 1934

Specimen examined: KUFC 3097 (toad)

Reference: Ellis, 1971

Colonies on PDA, reaching 6-6.5 cm diam. in 7 days at 28 ^{o}C. Mycelium grey to olivaceous brown, often raised in the middle, wrinkled. Conidiophores olivaceous to

blackish brown, smooth, 100-180 x 1.5-2.5 μm. Conidia oblong or ellipsoidal pale greyish green, smooth or sometimes minutely verruculose, 2.5-3.5 x 1.5-2 μm.

Oidiodendron griseum was reported from litter, soil and wood pulp in Europe, N. America and Trinidad (Ellis, 1971). Seifert *et al*. (1983) recorded *Oidiodendron* spp. on earthworm casts and horse dung. Yoganathan *et al.* (2003) reported two new compounds, 10-methoxydihydrofuscin and fuscinarin, and one known compound, fuscin isolated from the soil fungus *O. griseum*. These compounds were found to compete effectively with macrophage inflammatory protein (MIP)-1 alpha for binding to human CCR5, an important anti HIV-1 target that interferes with HIV entry into cells.

44. *Paecilomyces lilacinus* (Thom) Samson, 1974

Specimen examined: KUFC 3177, 3179, 3182, 3185 (barking deer); 3187, 3190, 3193, 3198 (buffalo); 3206 (camel); 3209, 3210, 3211, 3213, 3215, 3230, 3233 (cow); 3237, 3240, 3243, 3244, 3245 (deer); 3246, 3247, 3248, 3252, 3254, 3256 (elephant); 3265, 3267, 3269, 3271 (gaur); 3274, 3276, 3278, 3279 (goat); 3280 (horse); 3283, 3286, 3288, 3290 (rabbit); 3292, 3295 (rat) and 3296, 3298 (toad)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 5-7 cm diam. in 7 days at 28 ^{o}C. Mycelium vinaceous shades. Conidiophores mostly arising solitarity from the horizontal mycelium, stalks 3.5-5 μm wide, rough-walled, with densely clustered metulae and

phialides. Conidia ellipsoidal to fusiform, smooth-walled to slightly roughned, 2.5-3.0 x 2.0-2.5 μm.

The peptide antibiotics leucinostatin from *P. lilacinus* showed effectively against some gram positive bacteria and a wide range of fungi. This fungus can produce indole-3-acetic acid which stimulate the growth of barley seedlings (Domsch *et al*., 1993).

45. *Papulaspora immersa* Hotson, 1912

Specimen examined: KUFC 3180, 3181, 3183, 3186, 3194, 3196, 3197, 3200, 3204, 3212, 3216, 3219, 3221, 3224, 3227 (buffalo); 3235, 3237, 3240, 3243, 3245, 3249, 3250, 3252, 3254, 3257, 3259, 3261, 3264, 3266, 3268, 3271, 3273 (cow); 3275, 3277, 3280 (deer); 3282 (eld's deer); 3287, 3289, 3291, 3294, 3297, 3300, 3303, 3305, 3308, 3310 (elephant); 3312 (gaur); 3316, 3317, 3320, 3322 (goat) and 3324, 3325 (rat)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 8.0-9.0 cm diam. in 7 days at 28 ^{o}C. Mycelium black. Papulaspores originating from intercalary cells, pale brownish yellow, irregular-shape, 100-120 μm diam, often submerged in the agar, 28-60 μm diam.

P. immersa is the commonest species found on various dung samples (53 isolates) especially on cow dung. Subramanian (1983) stated that species of *Papulaspora* was recorded invariably and primarily on dung and excreta of animals but rarely, or not at all on other substrates. Domsch *et al*. (1993) mentioned that the original isolate of *P. immersa* was derived from horse, dog and rabbit dung in USA

and Canada. De Hoog *et al*. (2000) reported *P. equi* as the pathogens causing eye infection in horse.

46. *Penicillium* spp. Link ex Fr., 1821

Specimen examined: KUFC 3117, 3118, 3130, 3134 (buffalo); 3136, 3139 (cow); 3142 (deer); 3144 (eld's deer); 3148, 3150 (elephant); 3152, 3155 (gaur); 3174, 3175, 3176 (goat); 3178, 3184 (horse); 3188 (rabbit); 3191 (rat) and 3195 (toad)

Reference: Pitt (1979)

Penicillium sp. (KUFC 3117): Colonies on CZA, 1.5-1.8 cm diam. in 7 days at 28 ^{o}C. Mycelium blue green, reverse yellow to orange. Conidiophores 80-150 x 2-3 μm, smooth-walled with 3-4 metulae in a whorl, Metulae 15-18 x 2-2.5 μm. Phailides flask-shaped, 10-12 x 2-2.5 μm. Conidia globose, smooth-walled, greenish, 2.5-3.0 μm in diam.

47. *Pestalotiopsis guepinii* (Desm.) Stey., 1949

Specimen examined: KUFC 2869 (buffalo); 2871, 2872 (cow); 2877 (eld's deer); 2879 (gaur) and 2881 (horse)

Reference: Sutton (1980)

Colonies on PDA, reaching 5.0-6.0 cm diam. in 7 days at 28 ^{o}C. Mycelium white. Conidiomata acervular 100-200 μm diam., epidermal to subepidermal, separate or confluent, formed of brown, thin-walled textura angularis. Conidiophores 10-15 x 1-3 μm with 1-2 proliferation hyaline, branched and septate the base and above, cylindrical or lageniform, formed from the upper cells of the pseudoparenchyma.

Conidiogenous cells holoblastic, annellidic, indeterminate, integrated, cylindrical, hyaline, smooth, with several percurrent proliferations. Conidia fusiform, straight or slightly curved.

48. *Phialophora* spp. Medlar, 1915

Specimen examined: KUFC3189, 3192 (cow); 3199 (eld's deer) and 3203 (elephant)

Reference: Ellis (1971), Domsch *et al*. (1993)

Phialophora sp. (KUFC 3189): Colonies on PDA, reaching 7-8 cm diam. in 7 days at 28 ^{o}C. Mycelium effuse, brown or olivacoues brown, superficial, partly immersed. Conidiophores mononematous, branched, pale to olivaceous brown, smooth. Conidiogenous cells monophialidic, ampulliform, with well defined collarettes. Conidia simple, straight, ellipsoidal, colourless to pale brown, smooth, 0-septate, 3-5 x 1.5-2 μm.

Phialophora is a rather heterogeneous assemblage of anamorphs of unrelated ascomycetes, including *Pyrenopeziza*, *Mollisia*, *Ascocoryne*, *Coniochaeta* and *Gaeumannomyces* (Domsch *et al*., 1993).

49. *Pilobolus crystallinus* (Wiggers) Tode, 1784 (Figure 24)

Specimen examined: on elephant dung (non cultivated)

Reference: Bell (1983)

Sporangiophore stout, simple, with a subsporangial swelling and a basal swelling buried in the substrate. Sporangia tough walled, black projected some distance towards the light when mature. Spore pale yellow, 10 x 6-7 μm. (Figures 24A, 24B, 24C)

50. *Pithomyces karoo* Marasas & Schumann, 1972 (Figure 25)

Specimen examined: KUFC 3214 (cow) and 3217 (eld's deer)

Reference: Ellis (1976)

Colonies on PDA, reaching 9 cm in diam. in 7 days at 28 ^{o}C. Mycelium effuse, greyish olive or black. Conidia very variable in shape, eillipsoidal, pyriform, clavate, with 2-3 transverse septa and 1 longitudinal septum, dark brown, verrucose, 15.5 –28 x 10-15 μm (Figure 25)

Ellis (1976) recorded *Pithomyces kaloo* from *Avena*, *Gnidia* and *Rhigozum* in S. Africa and from wheat rhizosphere in Australia. Houbraken *et al*., (2006) reported *P. kaloo* and *P. quadratus* can produce atlenuene and some alternariols.

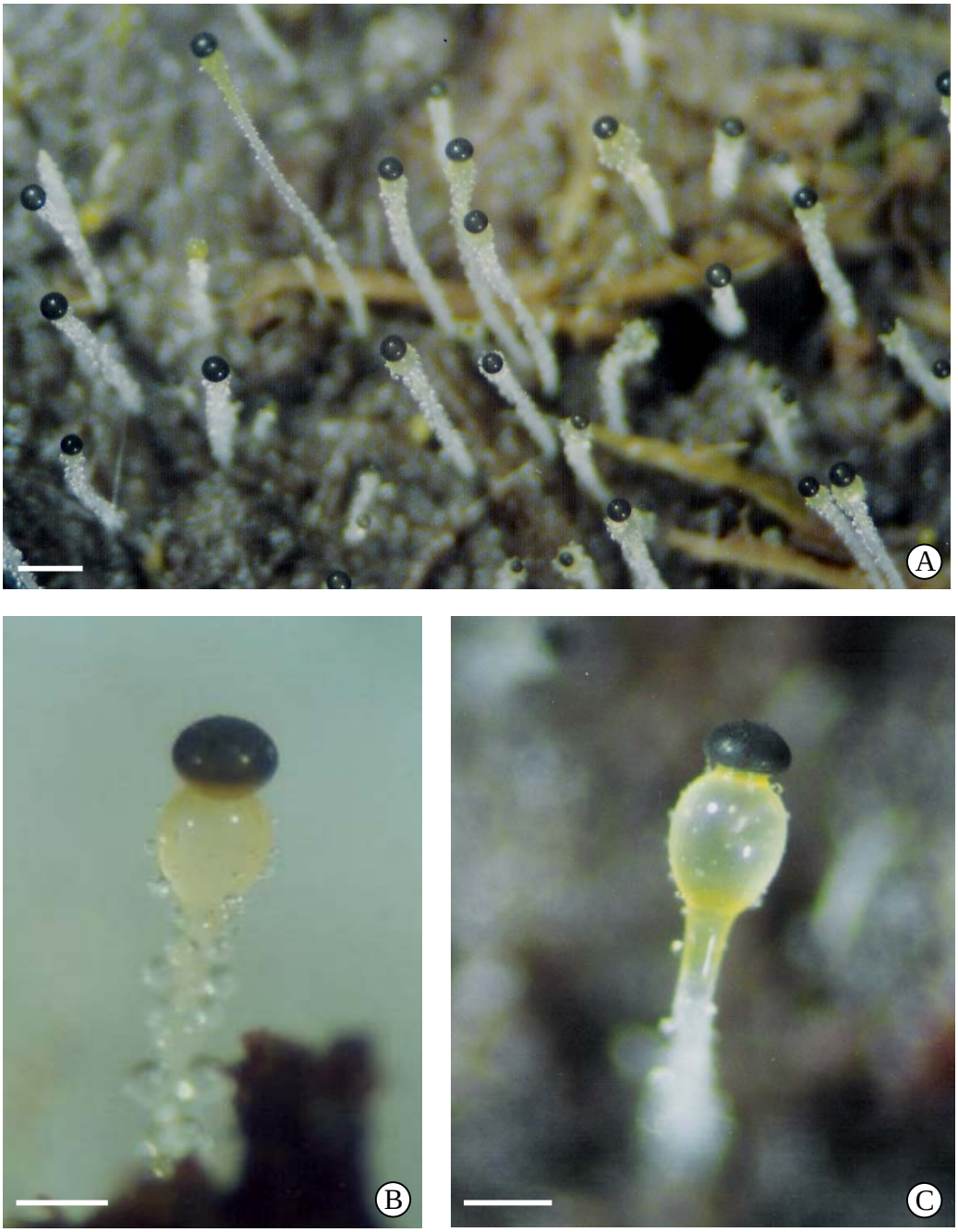


Figure 24 ***Pilobolus crystallinus*** (Wiggers) Tode

A-C. Sporangiophores with subsporangial swelling vesicle and sporangiospores on elephant dung (bars: A = 20 μm; B, C = 10 μm).

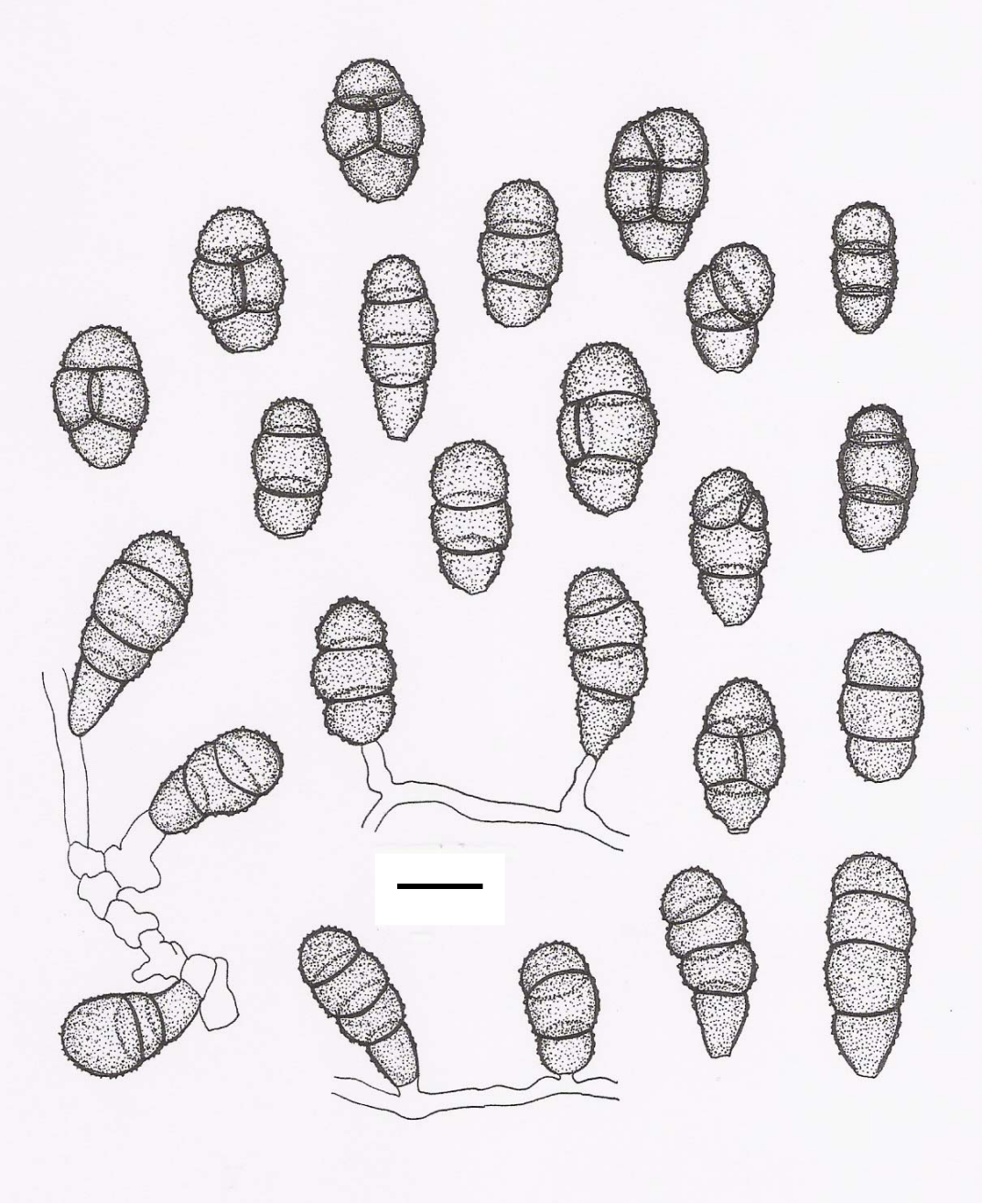


Figure 25 ***Pithomyces karoo*** Marasas & Schumann (KUFC 3214)

Camera lucida drawings of conidiophores and conidia (bar = 10 μm).

51. *Podosordaria leporina* (Ellis & Everh.) Dennis, 1957 (Figure 26)

Specimen examined: on rabbit dung (non cultivated)

Reference: Richardson and Watling (1997), Ellis and Ellis (1998)

Ascostroma conspicuous on dung, 0.2-0.8 mm (Figures 26A, 26B). Perithecia in a subglobose group at the tip of the stromatic stalk, 180-200 x 90-100 μm (Figures 26C, 26D, 26E). Asci 8-spored, cylindrical, colourless, 150-180 x 14-16 μm. Ascospores one-celled, ellipsoidal, dark brown, with germ-slit, slightly flattened on one side, 15-17.5 x 8-10 μm (Figure 26F).

Podosordaria leporina was reported on rabbit dung from Prachinburi Province. Ascospores are slightly flattened on side, 15-17.5 x 8-10 μm. Richardson and Watling (1997) described this fungus from England with ascospore (12) 14-19 x 6-9 μm. The stalks of stroma from our isolate were shorter than those described by Richardson and Watling (1997). Rogers *et al.* (1998) described *Podosordaria elephati* as a new species from elephant dung collected from Chachoengsao Province, Thailand. Bell (2005) reported *Podosordaria violaceae* from wallaby dung and *Podosordaria* sp. from Brush tail possum dung in Australia. *P. leporina* is a new record for Thailand.

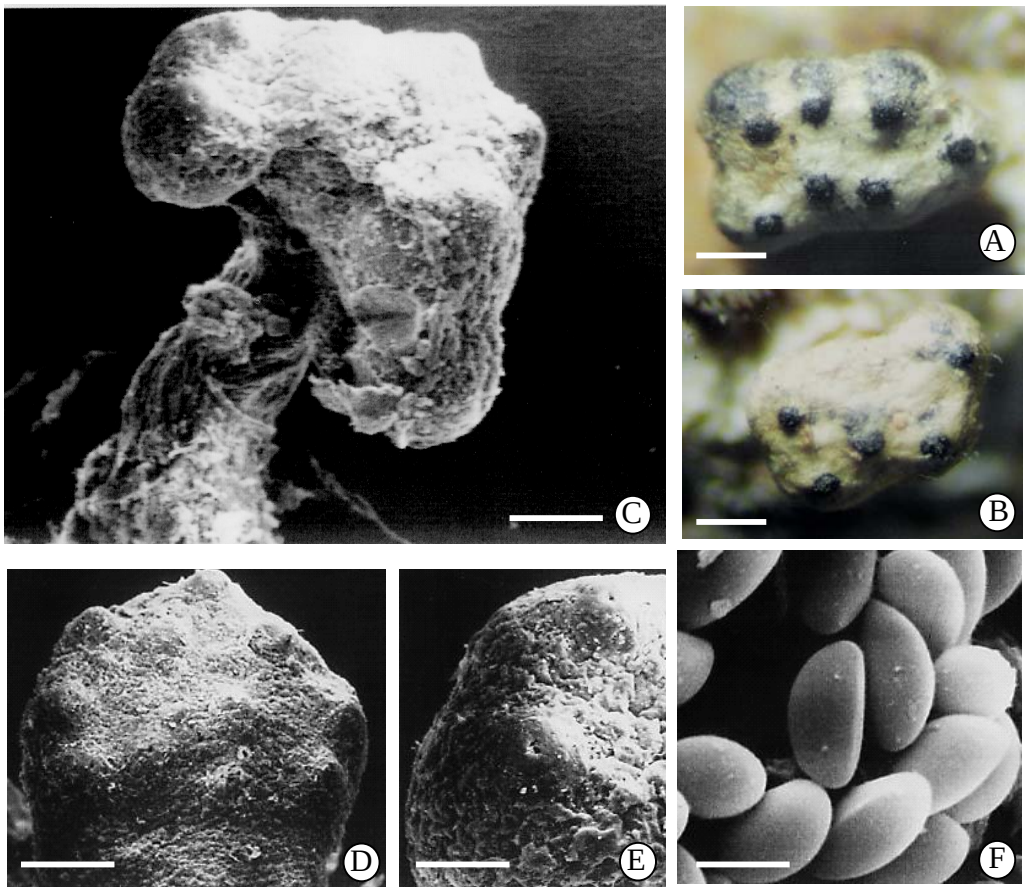


Figure 26 ***Podosordaria leporina*** (Ellis & Everh.) Dennis

A-B. Ascostroma on rabbit dung under stereomicroscope

C-F. SEM photomicrographs of ascostroma with perithecia and ascospores (bars: A, B = 0.2 mm; C, D = 100 μm; E = 50 μm; F = 10 μm).

52. *Podospora curvicolla* (Wint.) Niessl, 1883 (Figure 27)

Specimen examined: KUFC 2493

Reference: Lundqvist (1972), Bell (1983), Ellis and Ellis (1998)

Colonies on CMA growing slowly, reaching 5-5.5 cm diam. in 14 days at 28 ^{o}C (Figure 27A). Mycelium brown to dark brown, submerged, forming perithecia in 10-14 days. Perithecia obpyriform, with tufts of hair, immersed, brown to dark brown, 500-550 x 400-470 μm (Figure 27C). Asci 256-spored, broadly clavate, colourless, 200-230 x 60-110 μm (Figure 27D). Ascospores one-celled, subglobose to ellipsoidal, hyaline when young, becoming brown to dark brown, 15-16 x 9-10 μm; hyaline pedicel, 10-12 x 2-2.5 μm (Figure 27B).

Podospora curvicolla was reported on lagomorph and possum dung in New Zealand (Bell 1983); on cow, goat, rabbit, sheep and yellow ox dung in Taiwan (Wang 2000). In Thailand, Manoch *et al*. (1999) recorded *P. curvicolla*, *P. communis* and *P. anserine* from deer dung.

53. *Rhizoctonia* sp. J.G. Kühn, 1858

Specimen examined: KUFC 3210 (cow)

Colonies on PDA, reaching 9 cm in diam. in 7 days at 28 ^{o}C. Mycelium pale brown, with cottony aerial mycelium. Vegetative hyphae hyaline turned to yellow, brown when mature, septate, branching at upright angles, moniloid cells absent.

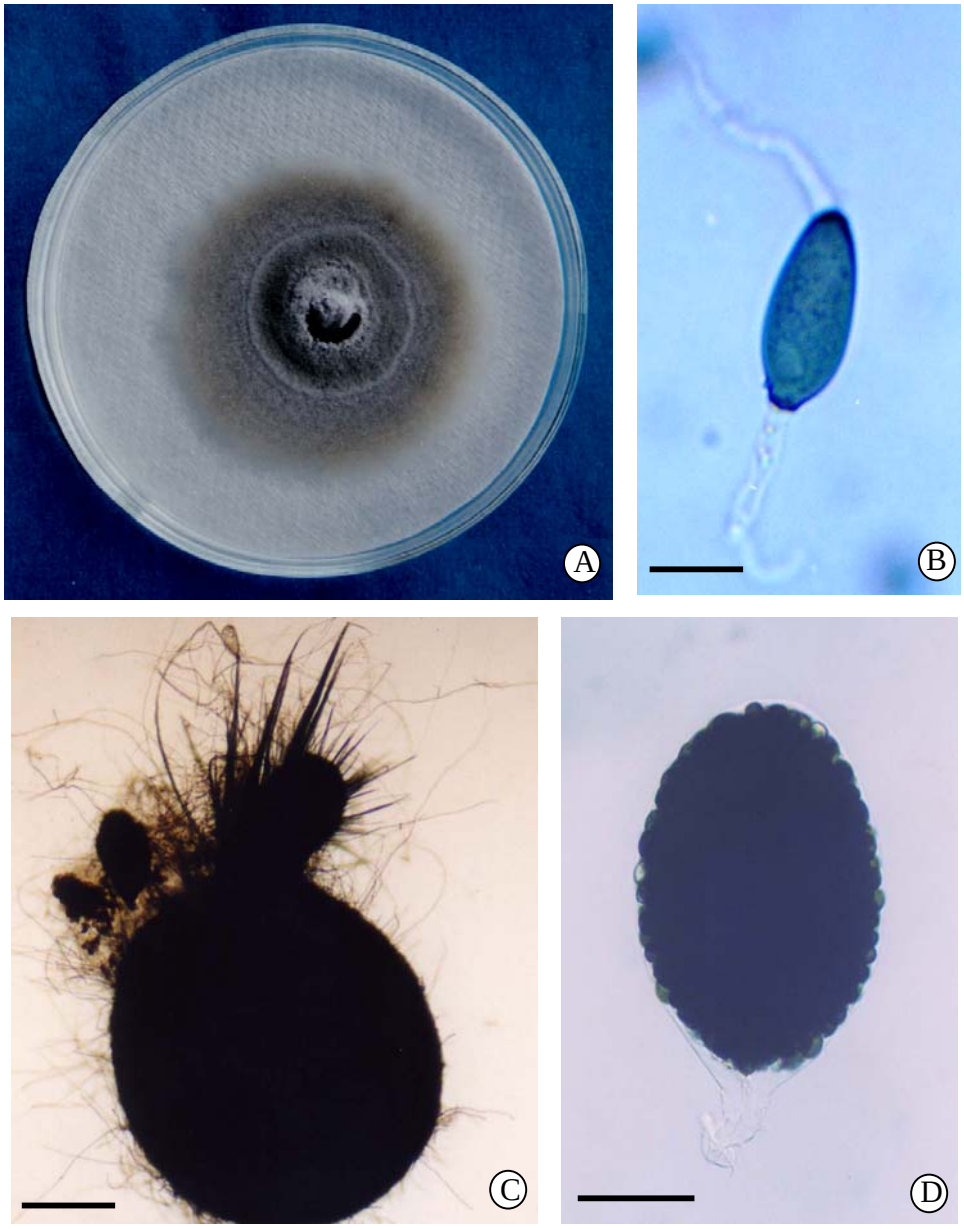


Figure 27 ***Podospora curvicolla*** (Wint.) Niessl (KUFC 2493)
A. Colony on CMA, 14 days at 28 ^{o}C; B. Ascospore with gelatinous appendages; C. Perithecium; D. Ascus and ascospores
(bars: B = 10 μm; C = 100 μm; D = 50 μm).

54. *Rhizopus oryzae* Went & Prinsen Geerligs, 1895 (Figure 28)

Specimen examined: KUFC 2743 (buffalo); 2747 (camel); 2750, 2753, 2756 (cow); 2748, 2751 (deer); 2754 (eld deer); 2756, 2759 (gaur); 2761 (goat); 2763 (horse); 2765 (rabbit) and 2767 (rat)

Reference: Domsch *et al*. (1993)

Colonies on PDA reaching 9 cm diam. in 2-3 days at 28 ^{o}C. Mycelium pale or dark grey, some tendency to collapse. Stolons hyaline produed a rhizoid. Sporangiophores arising directly from stolons or aerial hyphae. Sporangia 100-200 μm diam., wall diffluent, grey to black. Columella and apophysis globose, soon collapsing after spore release. Sporagiospore subglobose, surface ridged 6-10 x 5-7 μm (Figure 28).

55. *Rhizopus stolonifer* (Ehrenb. Ex Link) Lind, 1913

Specimen examined: KUFC 2713 (barking deer); 2717 (buffalo); 2722, 2725, 2729, 2731 (cow); 2733 (eld's deer); 2739 (elephant) and 2741 (rabbit).

Reference: Domsch *et al*. (1993)

Colonies on PDA reaching 9 cm diam. in 2-3 days at 28 ^{o}C. Mycelium grey-brown. Stolons hyaline to brown, 13-20 μm wide, abundantly branched rhizoids 300-350 μm long. Sporangiophores pale to dark brown, usually straight, mostly 1.5-3.0 mm tall. Sporangia black, mostly 100-200 μm diam; columella subglobose, biconical to oval, ridged7-12 x 6-8.5 μm, mostly 4 nucleate.

Rhizopus stolonifer is one of the commonest members of the Mucorales and has a worldwide distribution, although most commonly occurring in warmer areas. It has frequently been reported from dry habitats (Domsch *et al*., 1993).

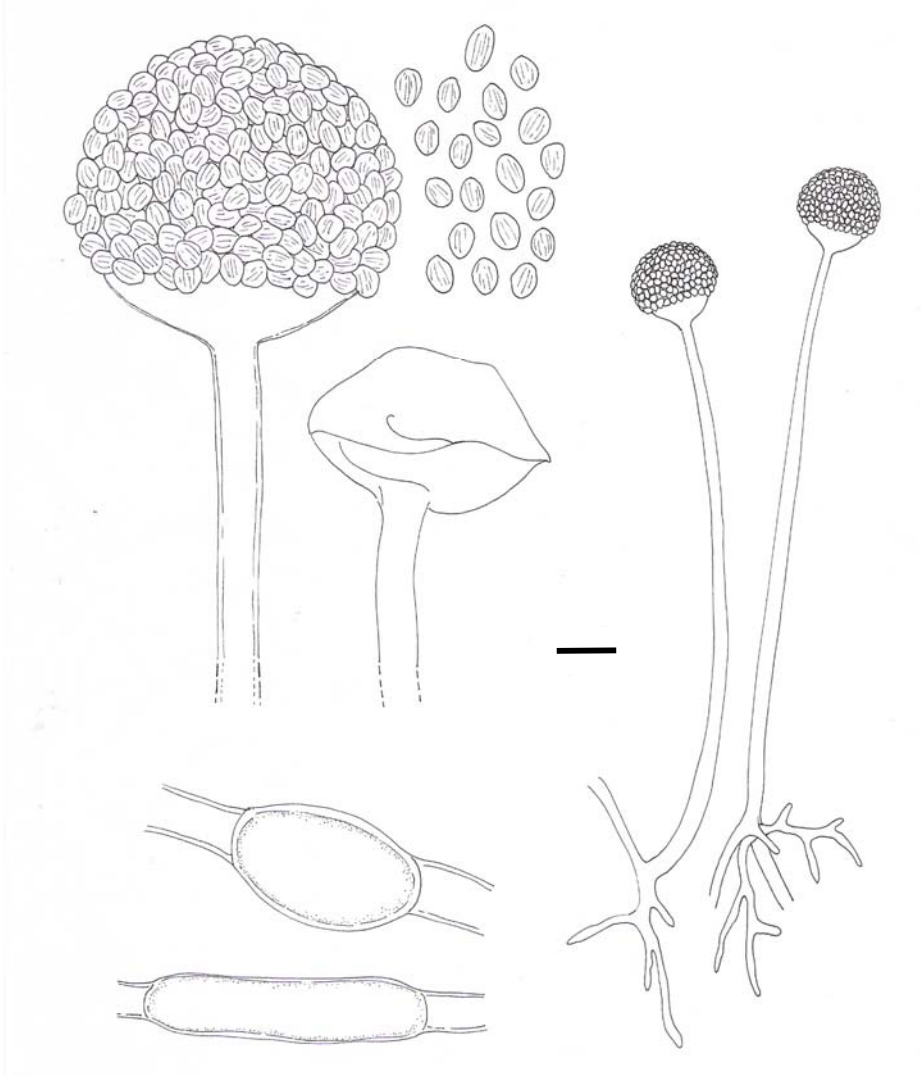


Figure 28 ***Rhizopus oryzae*** Went & Prinsen Geerligs (KUFC 2743) Camera lucida drawings of sporangiophores, sporangiospores and chlamydospores (bar = 10 μm).

56. *Saccobolus glaber* (Pers.) Lambotte, 1887 (Figure 29)

Specimen examined: on elephant dung (non cultivated)

Reference: Bell (1983), Richardson and Watling (1997), Ellis and Ellis (1998)

Apothecia produced on dung after 2 days incubation at 28 ^{o}C, soft-fleshed, pale yellowish, 100-120 x 25-30 μm (Figures 29A, 29B, 29C, 29E). Asci 8-spored, unitunicate, cylindrical with operculum, at maturity elongating to project above the surface of apothecium, the spores within standing out as dark dots under stereomicroscope (Figure 29D). Ascospores one-celled, ellipsoidal with truncated ends, purple, smooth-walled, 20-25 x 10-14 μm, firmly joined together with mucilage both in the ascus and after ejection (Figure 29F).

Saccobolus glaber was found on elephant dung using the moist chamber method but failed to grow on agar media. Somrithipol (2004) recorded the following *Saccobolus* from Thailand: *S. citrinus*, *S. glaber*, *S. minimus*, *S. succineus*, *S. thaxteri* and *S. truncatus*. van Brummelen (1967) reported *S. minimus*, *S. thaxteri*, *S. truncatus* from animal dung in Thailand and described *S. succineus* as a new species collected from elephant and horse dung from Kanchanaburi Province (van Brummelen 1969). Manoch (2000) reported *S. citrinus* from deer, banteng and cow dung from Huay Kha Khang Wildlife Sanctuary, Uthai Thani Province; Khoa Yai National Park, Nakhon Ratchasima Province and Loei Province, Northern Thailand. Somrithipol and Hywel-Jones (2002) found *S. citrinus*, *S. glaber* and *S. thaxteri* from various dung including sambar deer, barking deer, Asian elephant and cattle from Northeastern Thailand.

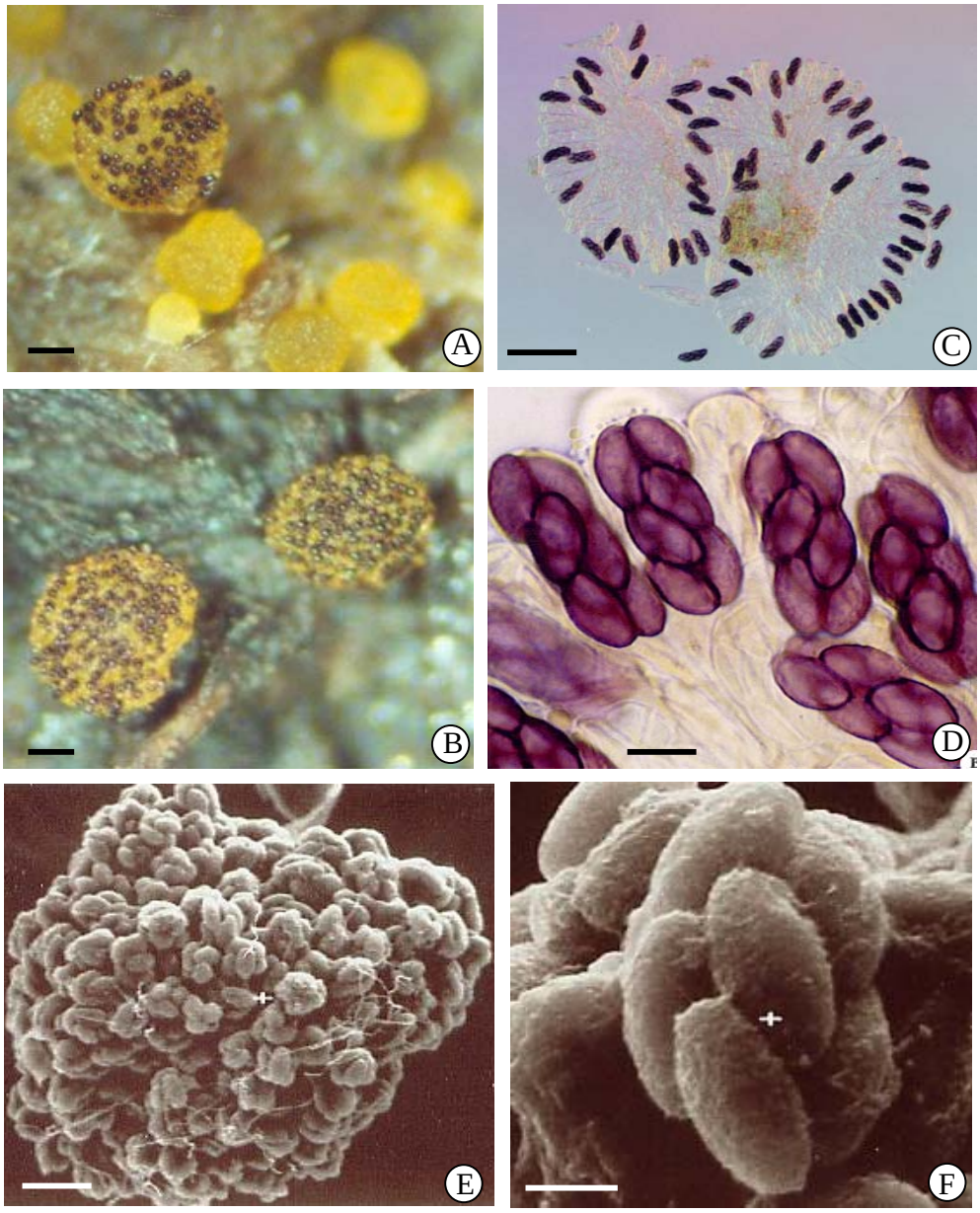


Figure 29 ***Saccobolus glaber*** (Pers. per Pers.) Lamb.

A, B. Apothecia on elephant dung; C, D. Asci and ascospores

E, F. SEM photomicrographs of apothecium, asci and ascospores

(bars: A, B = 0.2 μm; C = 100 μm; D = 20 μm; E = 50 μm; F = 10 μm).

57. *Scopulariopsis brevicaulis* (Sacc.) Bainier, 1907

Specimen examined: KUFC 3158 (barking deer); 3161, 3162, 3163, 3168, 3170 (buffalo); 3202, 3205 (cow); 3220, 3222, 3230, 3231(deer); 3236, 3238, 3239 (eld's deer); 3251, 3253, 3260, 3263, 3270, 3281, 3284 (elephant); 3285, 3299 (horse); 3304, 3307, 3311, 3313 (rabbit) and 3315 (rat)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 4-5 cm in diam. in 7 days at 28 ^{o}C. Mycelium buff to brown with a narrow white margin. Annellides arising in groups of 2-3 on short stipes, 10-25 μm long, colourless or very pale. Conidia brown in mass but very pale when viewed singly, subspherical or obovoid, truncate at the base, smooth when young, coaesely verrucose when mature, 5.5-8 x 5-7.5 μm.

S. brevicaulis was common and widespread, isolated from air, animal and various substrates (Domsch, *et al*., 1993). This species is the anamorph state of *Microascus brevicaulis* Abbott, it was reported frequently involved in onychomycoses in human and animal (de Hoog *et al*., 2000)

58. *Scytalidium lignicola* Pesante, 1957

Specimen examined: KUFC 3165, 3166 (cow), 3172 (deer) and 2889 (elephant)

Reference: Ellis (1971)

Colonies on PDA, reaching 5-6 cm in diam. in 7 days at 28 ^{o}C. Mycelium dark blackish brown, immersed, smooth, some narrow, cylindrical, colourless 2-6 μm

thick, swollen cells 10 μm thick. Conidiophores synnematous, unbranched, straight, colourless or brown, smooth. Conidia catenate, simple, brown, smooth, 0 septate, 6-9 x 2-2.5 μm.

S. lignicola as the type species of the *Scytalidium*. There are numerous reports from wood of *Pinus* and *Platanus*, roots of *Vitis* and from soil in Cyperus, Great Britain, India, Italy and Rhodesia (Ellis, 1971).

59. *Sordaria fimicola* (Roberge ex Desm.) Ces. & De Not., 1863 (Figure 30)

Specimens examined: KUFC 2497 (cow); 2495, 2496, 2498, 2499 (deer); 2500, 2501 (barking deer); 2502 (buffalo); 2503 (gaur); 2504 (rabbit); 2505, 2506 (goat); 2507 (cow); 2508 (camel) and 2509, 2510 (eld's deer)

Reference: Lundqvist (1972), Ellis and Ellis (1998)

Colonies on PDA growing rapidly, reaching 9 cm diam. in 7 days at 28 ^{o}C. Mycelium brown to dark brown, homothallic, forming perithecia within 7-10 days. Perithecia generally crowded, obpyriform, superficial, dark brown, 300-400 x 250-330 μm (Figures 30A, 30B). Asci 8-spored, unitunicate, cylindrical, short stipitate, with truncate apex from thickened apical ring, colourless, 160-200 x 15-17 μm (Figure 30C). Ascospores one-celled, ovoid to ellipsoidal, hyaline when young, becoming brown to dark brown, 15-20 x 10-12 μm, with germ pore at the apiculate basal end, covered with a wide gelatinous sheath (Figures 30D, 30E, 30F).

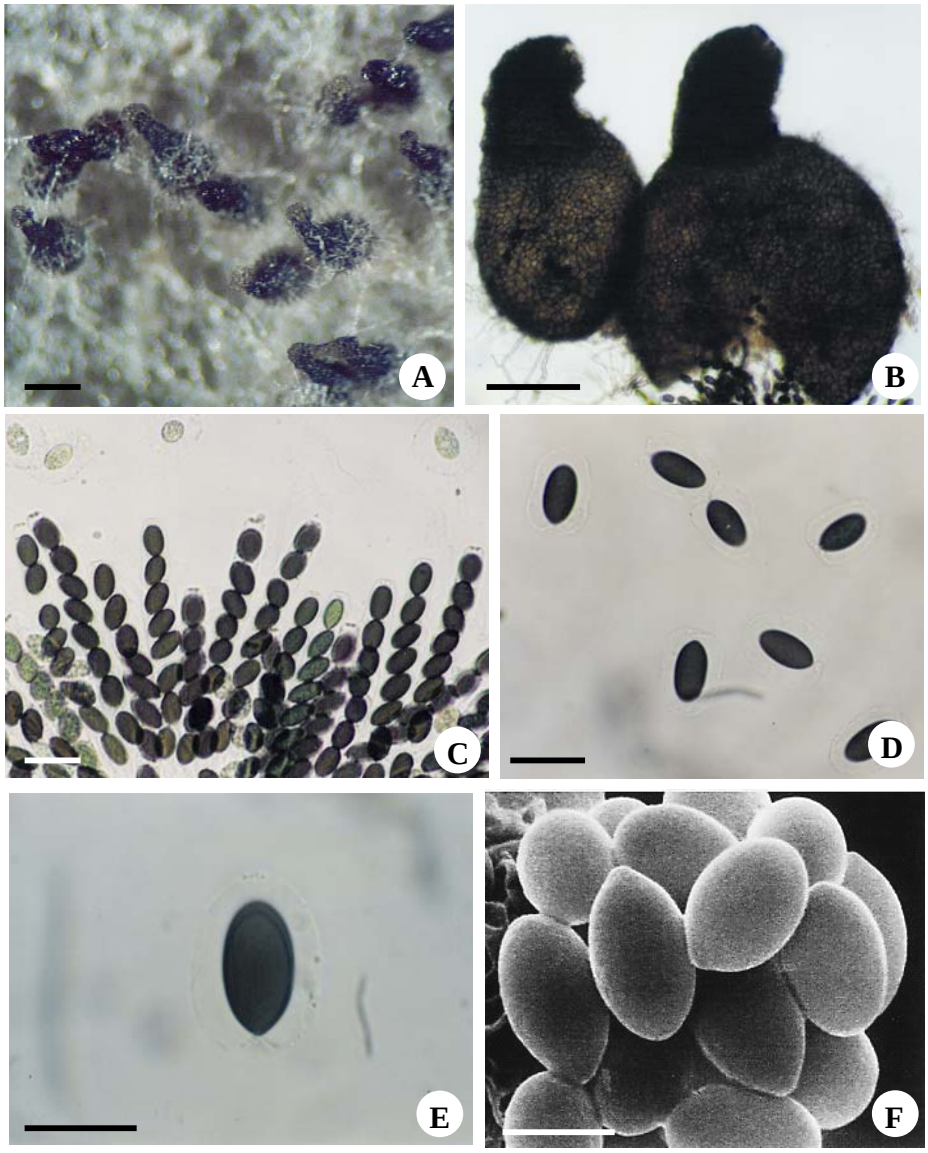


Figure 30 ***Sordaria fimicola*** (Roberge ex Desm.) Ces. & de Not. Lamb (KUFC 2495)

A. Perithecia under stereomicroscope; B-E. Light photomicrographs showing B. Perithecia; C. Asci and ascospores; D-E. Ascospores with gelatinous sheath; F. SEM photomicrograph of ascospores (bars: A, B = 100 μm; C, D, E = 20 μm; F = 10 μm).

S. fimicola differs from other species of Sordariaceae in the aggregation of the ascogenous cell to form a placenta-like mass in the base of the centrum and the asci arise in a cluster rather than in a uniform wall layer (Mai, 1977). The closest species is *S. destruens* (Shear) Hawker, which produces similar but highly granular ascospores usually lacking a gelatinous sheath. *S. humata* (Fuckel) Wint. has broader ascospores (15.5-18 μm) without a gelatinous sheath, and *S. lappae* Poteb. similar ascospores with a gelatinous sheath (Domsch *et al*., 1993).

S. fimicola has been recorded from various kinds of animals, mostly herbivorous dung from many countries (Bell 1983, 2005; Domsch *et al*., 1993; Richardson and Watling 1997; Elshafie 2005). Bell (1983, 2005) reported *S. fimicola* from rabbit, possum, deer and cat dung in New Zealand and from eastern grey kangaroo, macropod, rabbit, cat, brush tail possum, quokka, ring tail possum, wallaby, wallaroo and wombat in Australia. Elshafie (2005) reported that *S. fimicola* was extremely uncommon in Oman and only one isolate was found on cattle dung. In Thailand, Manoch *et al*. (1999) recorded two isolates of *S. fimicola* on deer and banteng dung from Huay Kha Khang Wild Life Sanctuary, Uthaithani province using the heat treatment method. This fungus can utilize acetate and D-glucose. Numerous sugars give increasing growth with rising concentration, although fewer perithecia are formed. Various cellulose-containing substrates are decomposed and usnic acid can also be degraded by *S. fimicola* (Domsch *et al*., 1993). *S. fimicola* has often been used as a model of a homothallic ascomycete suited for genetic variation studies because it can complete its development within eight days (Lamb *et al*., 1998; Saleem *et al*., 2001).

60. *Sporormiella minima* Auersw. Ahmed & Cain, 1970 (Figures 31, 32)

Specimens examined: KUFC 2511 (deer); 2512, 2518 (cow); 2513 (buffalo); 2514 (rabbit); 2515, 2516 (goat); 2517, 2519 (rat) and 2520 (toad)

Reference: Ahmed and Cain (1972), Bell (1983), Ellis and Ellis (1998)

Colonies on PDA growing slowly, reaching 5-5.5 cm diam. in 14 days at 28 ^{o}C (Figure 31A). Mycelium whitish to pale brown, submerged, forming perithecia in 10-14 days. Perithecia subglobose or pyriform, immersed when young and becoming superficial at maturity, dark brown, peridium thin, membranaceous, scattered or loosely aggregated, 100-150 x 85-100 μm (Figure 31B, 32). Asci 8-spored, unitunicate, cylindrical, broadly rounded above, shortly stipitate, colourless, 80-110 x 15-18 μm. Ascospores four-celled, cylindrical, broadly rounded at the ends, straight or curved, each spore free and surrounded by its own gelatinous sheath, 32-35 x 5-6.5 μm, tending to break in two at the middle septum (Figures 31C, 31D, 32).

Sixty-six species of *Sporormiella* were recorded by Ahmed and Cain (1972). They also reported *S. minima* on several dung samples, such as bear, carnivore, cow, deer, fox, goat, horse, moose, rabbit and sheep from Europe, Canada, Mexico and the United States. Bell (2005) reported this fungus from kangaroo, wallaby, wallaroo, wombat and wallby dung from Austraria. Richardson (2001a) found this fungus on sheep, deer, cattle, rabbit, hare and grouse. In the present study, *S. minima* has been reported as the dominant coprophilous ascomycete. Ten isolates were found on 7 different dung samples (Table 9). It is a new record for Thailand.

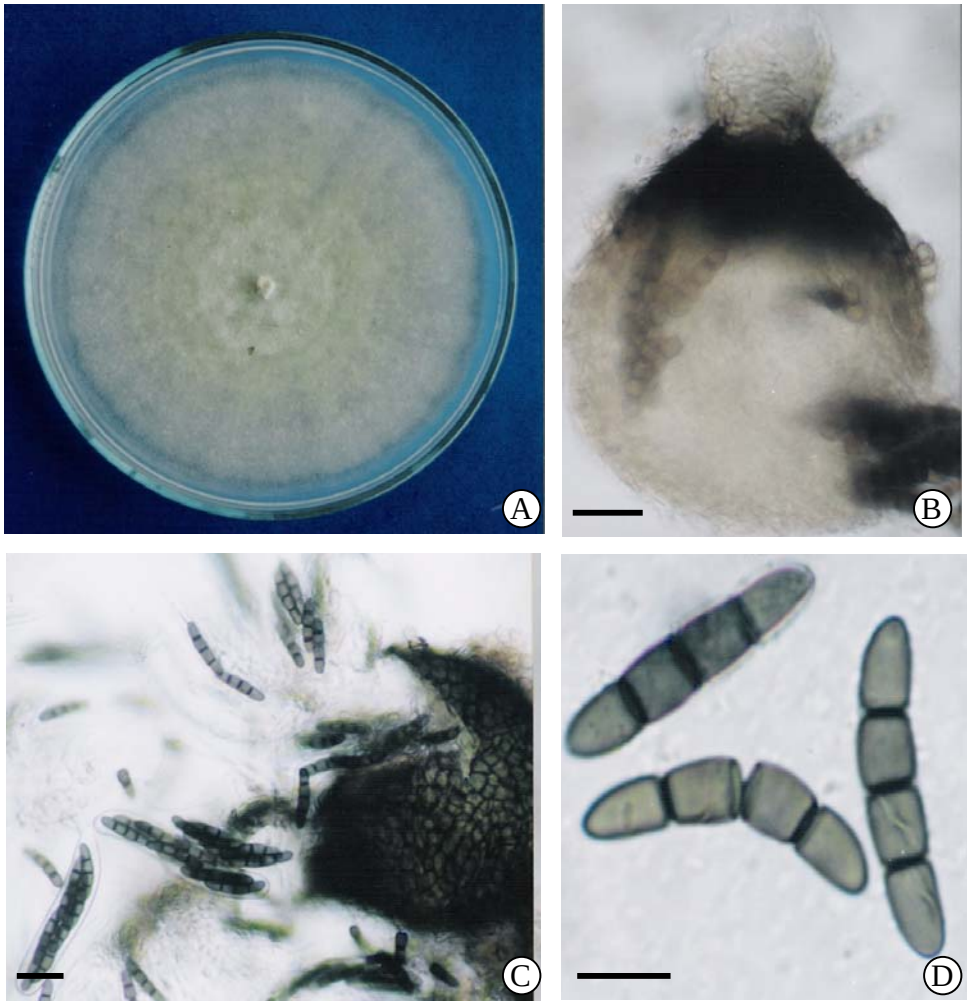


Figure 31 ***Sporormiella minima*** Auersw. Ahmed & Cain (KUFC 2511)
A. Colony on PDA, 20 days at 28 ^{o}C; B. Perithecium
C. Perithecium, asci and ascospores; D. Ascospores with germ slit
(bars: B, C = 20 μm; D = 10 μm).

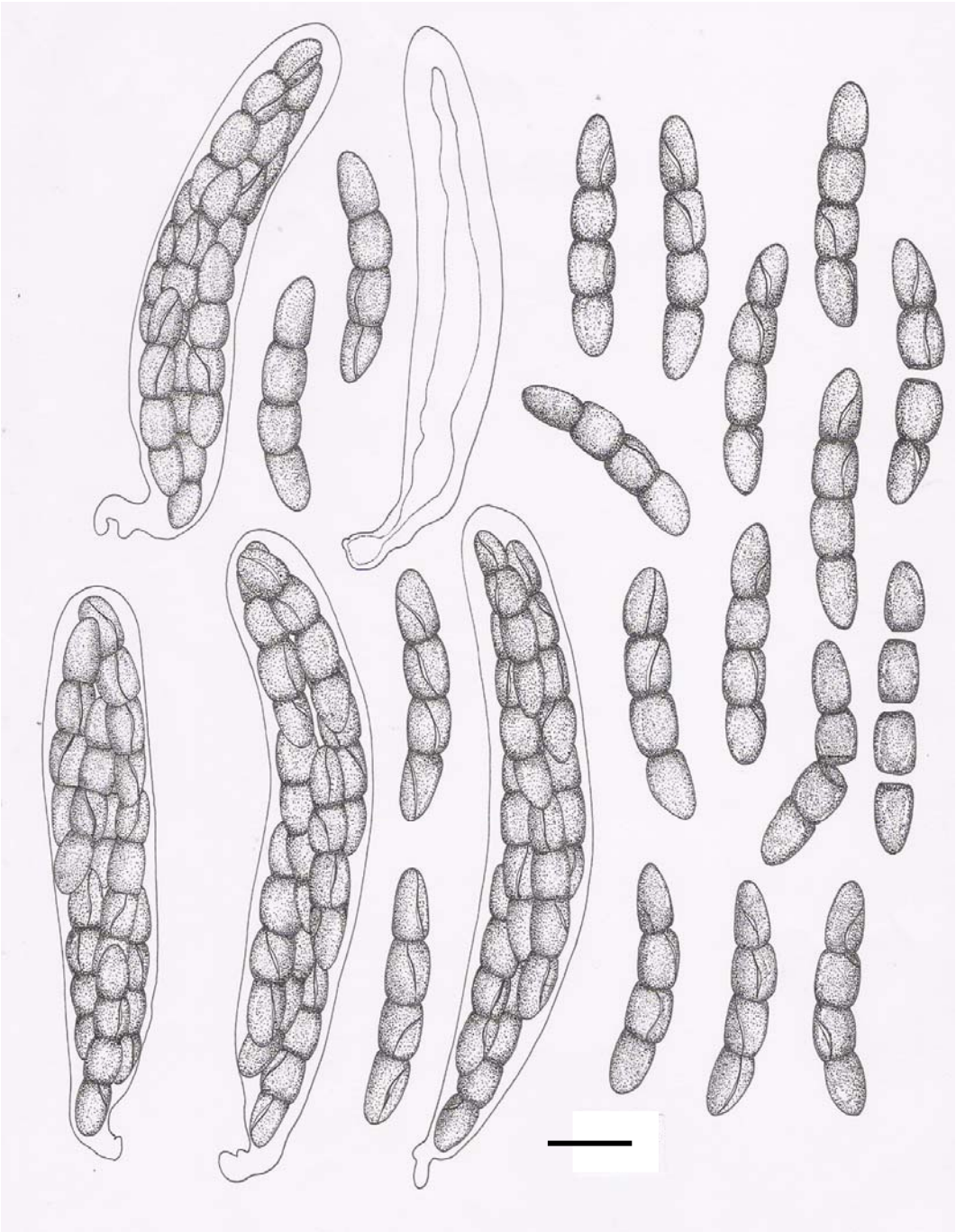


Figure 32 ***Sporormiella minima*** Auersw. Ahmed & Cain (KUFC 2511)
Camera lucida drawing of asci and ascospores (bar = 10 μm).

61. *Stachybotrys atra* Mathur and Sankhla, 1966

Specimens examined: KUFC 3207 (toad)

Reference: Ellis (1971)

Colonies on PDA, reaching 5-6 cm in diam. in 7 days at 28 ^{o}C. Mycelium black, supperficial and immersed. Conidiophores at first hyaline but soon becoming olivaceous brown to black, up to 100 μm long, 3.5-5 μm thick. Phialides mostly 12-13 x 4.5-6 μm in the broadest part. Conidia broadly ellipsoidal, dark brown to black, verrucose, 8.5-10 x 6-10 μm.

Ellis (1976) reported *S. altra* as a common and frequently isolated from paper, seeds, soil, textiles and dead plants in many countries. Moss (2003) stated that *S. atra* was originally implicated in stachybotryotoxicosis of farm animals, especially horses fed on contaminated mouldy hay, and occasionally with the people handling such hay (Moss, 2003).

62. *Syncephalastrum racemosum* Cohn ex J. Schröt, 1886

Specimens examined: KUFC 2749, 2752 (cow)

Reference: Domsch *et al*. (1993)

Colonies on PDA fast growing, reaching 9 cm in diam. in 7 days at 28 ^{o}C. Mycelium grey. Sporangiophores 10-12 μm wide, simple or branched. Vesicles up to 27.5 μm long, hyaline or pale brown. Merosporangia pale brown, cylindrical, with 1-8 sporangiospores. Sporangiospores globose or subglobose, smooth-walled, hyaline, pale brown, 3-4.5 μm.

63. *Talaromyces bacillisporus* (Swift) C.R. Benj., 1955

Specimens examined: KUFC 2803, 2804, 2808, 2812 (buffalo); 2814, 2817, 2719 (cow); 2822 (elephant); 2824 (gaur); 2827(goat); 2829 (horse); 2835, 2836 (rabbit) and 2839 (rat)

Reference: Pitt (1979)

Colonies on PDA reaching 2-2.5 cm in diam. in 7 days at 28 ^{o}C., reverse very dark green. Ascospore spherical, 3.5-4.5 μm with spinose wall. Conidiophores borne from aerial hyphae, stipes 20-50 μm long, with thick, smooth to rough walls. Penicilli monoverticilate or biverticillate, with elements rough walled. Phialides acerose, 10-12 μm long, often with finely roughened walls. Conidia mostly cylindrical and very narrow, 4.0-5.0 x 1.0-1.5 μm, smooth walled.

Talaromyces bacillisporus is regarded as a very rare species; however its repeated isolated isolation from pasteurised fruit juice products (Pitt and Hocking, 1997)

64. *Talaromyces flavus* (Klocker) Stolk and Samson, 1972

Specimens examined: KUFC 2818 (barking deer); 2823, 2825, 2828 (buffalo); 2832 (camel); 2834, 2837 (cow); 2841, 2843 (deer); 2844, 2846 (elephant); 2847 (gaur); 2850 (goat); 2852 (horse); 2854, 2855 (rat) and 2860, 2861 (toad)

Reference: Pitt (1979)

Colonies on MEA reaching 3-5 cm in diam. in 7 days at 28 ^{o}C. Gymnothecia of tightly interwoven mycelium, bright yellow, about 200-450 μm

diam, closely packed, maturing within 10-14 days. Ascospores yellow, ellipsoidal, 4.0-5.0 μm long, with spinose walls. Conidiophores borne from aerial hyphae, stipes 20-80 μm long, bearing terminal biverticillate or less commonly monoverticillate. Phialides acerose, 10-16 μm long. Conidia ellipsoidal to fusiform, 2.5-3.5 μm long, with smooth to spinulose walls.

65. ***Talaromyces rotundus*** (Raper & Fennell) C.R. Benj., 1955

Specimens examined: KUFC 2833 (elephant); 2838 (horse); 2840 (rabbit) and 2842 (rat)

Reference: Pitt (1979)

Colonies on MEA reaching 2-2.5 cm in diam. in 7 days at 28 ^{o}C. Mycelium white at the peripheries, then in annular zones of pale yellow but centrally yellowish orange. Gymnothecia deer yellow, about 200-300 μm diam, peridia composed of finely interwoven hyphae. Asci borne in chains. Ascospores sphaerical, 4-4.5 μm diam, with spinose walls. Conidiophores mostly from aerial hyphae at the margins of nearly mature colonies, stipes 20-60 x 1.5-2.2 μm. Phialides 12-14 x 2.0-2.2 μm. Conidia ellipsoidal to fusiform, 4.0-4.5 x 2.0-2.2 μm.

66. ***Talaromyces wortmanii*** (Klöcker) C.R. Benj., 1972

Specimens examined: KUFC 2845 (camel); 2848 (elephant) and 2851 (horse)

Reference: Pitt (1979)

Colonies on MEA reaching 1.5-2.3 cm in diam. in 7 days at 28 ^{o}C. Mycelium at the margins primrose yellow, reverse orange brown to deep orange

brown. Gymnothecia of loosely interwoven yellow hyphae, about 150-200 μm diam. Asci ellipsoidal, borne in chains. Ascospores 3.5-4 x 2.5-3 μm with walls spinulose to spinose. Conidiophores borne from surface or aerial mycelium, stipes 100-120 x 1.8-2.5 μm. Phialides acerose, 8-10 x 2.0-2.2 μm. Conidia ellipsoidal to fusiform, 2.5-3 x 2.0-2.2 μm.

67. *Thielavia terricola* (Gilman & Abbott) Emmons, 1930 (Figure 33)

Specimens examined: KUFC 2849 (buffalo); 2853, 2856, 2857 (cow) and 2858 (goat)

Reference: Domsch *et al*. (1993)

Colonies on PDA reaching 9 cm diam. in 7 days at 28 ^{o}C (Figure 33A) Mycelium forming a white mat which darkens with the development of the dark brown to black ascomata; reverse white to pale orange. Perithecium submerged, globose, dark brown, 100-150 μm (Figure 33C). Asci pyriform to ellipsoidal containing 8 ascospores, 20-40 x 15-20 μm. Ascospores broadly fusiform with slightly rounded ends, brown, with a distinct germ pore at one end, 12-14 x 7-8.5 μm (Figure 33B).

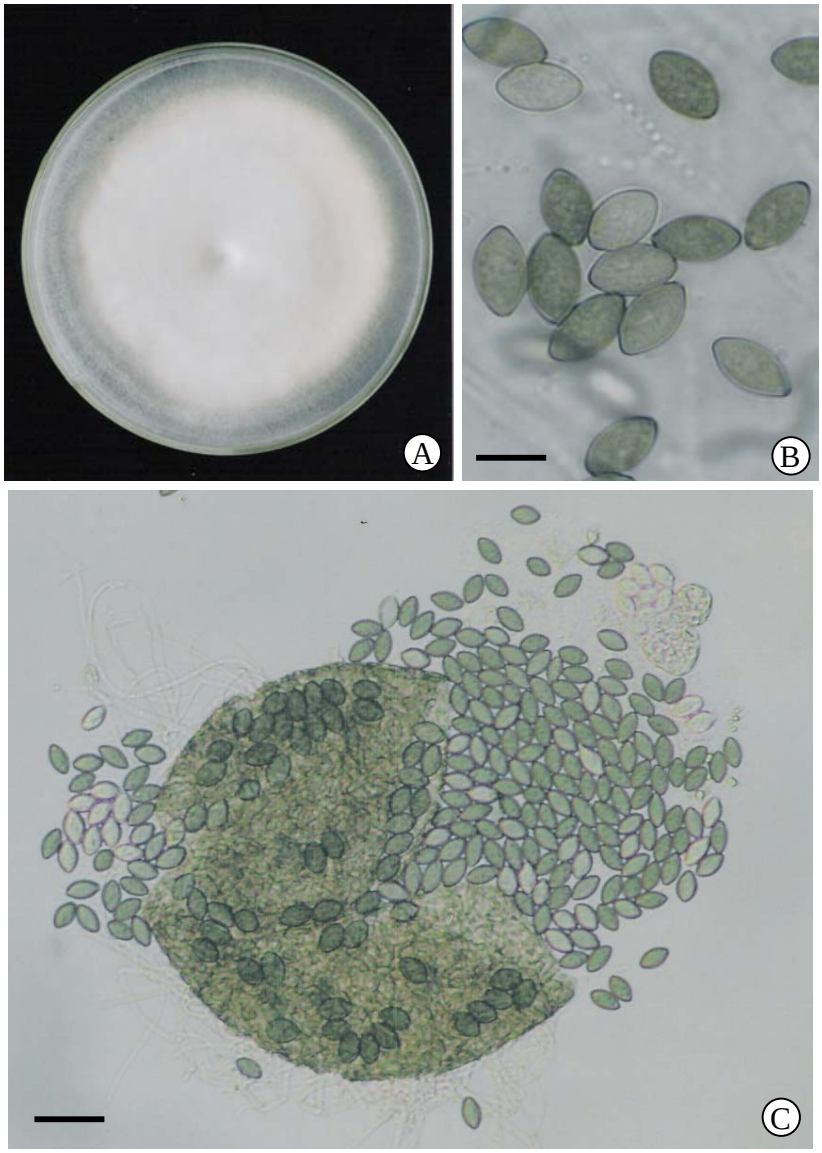


Figure 33 ***Thielavia terricola*** (Gilman & Abbott) Emmons (KUFC 2853)

A. Colony on PDA 7 days at 28 ^{o}C; B. Ascospores

C. Perithecium, asci and ascospores (bars: B = 10 μm, C = 20 μm)

68. ***Thielaviopsis*** **state of** ***Ceratocystis paradoxa*** (Dade) C. Moreau, 1952 (Figure 34)

Specimens examined: KUFC 3208 (elephant)

Reference: Ellis (1971)

Colonies on PDA attaining 9 cm in diam. in 7 days at 28 ^{o}C (Figure 34A). Mycelium dark brown to black. Conidiophores colourless to pale brown, up to 52-60 x 4-4.5 μm. Phialides up to 200-300 μm. Phialoconidia colourless, in the long chains, at first cylindrical and colourless, becoming ellipsoidal and mid golden brown, 7-12 x 4-6 μm (Figure 34B, 34C). Arthroconidia catenate, ellipsoidal, smooth, dark browm, with longitudinal slit, 12-25 x 10-15 μm (Figure 34D).

Weber and Tribe (2004) reported that *Thielaviopsis basicola* and *T. thielavioides* are soil-borne fungi found on surfaces of many different plants. Manoch *et al*. (2004) reported these two species from storaged carrot.

69. ***Trichoderma hamatum*** (Bonord.) Bain, 1906

Specimens examined: KUFC 3218, 3223 (barking deer); 3225 (buffalo); 3226, 3232, 3234, 3241 (cow); 3242 (elephant); 3255 (goat); 3258 (horse) and 3293, 3301, 3302 (toad)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 9 cm diam. in 7 days at 28 ^{o}C. Mycelium greyish green from a cover of mostly curled sterile conidiophore ends. Branches and phialides are particularly broad, 3-4 μm wide, Conidia short-cylindrical, green, smooth-walled, 3.5-5 x 2-3 μm.

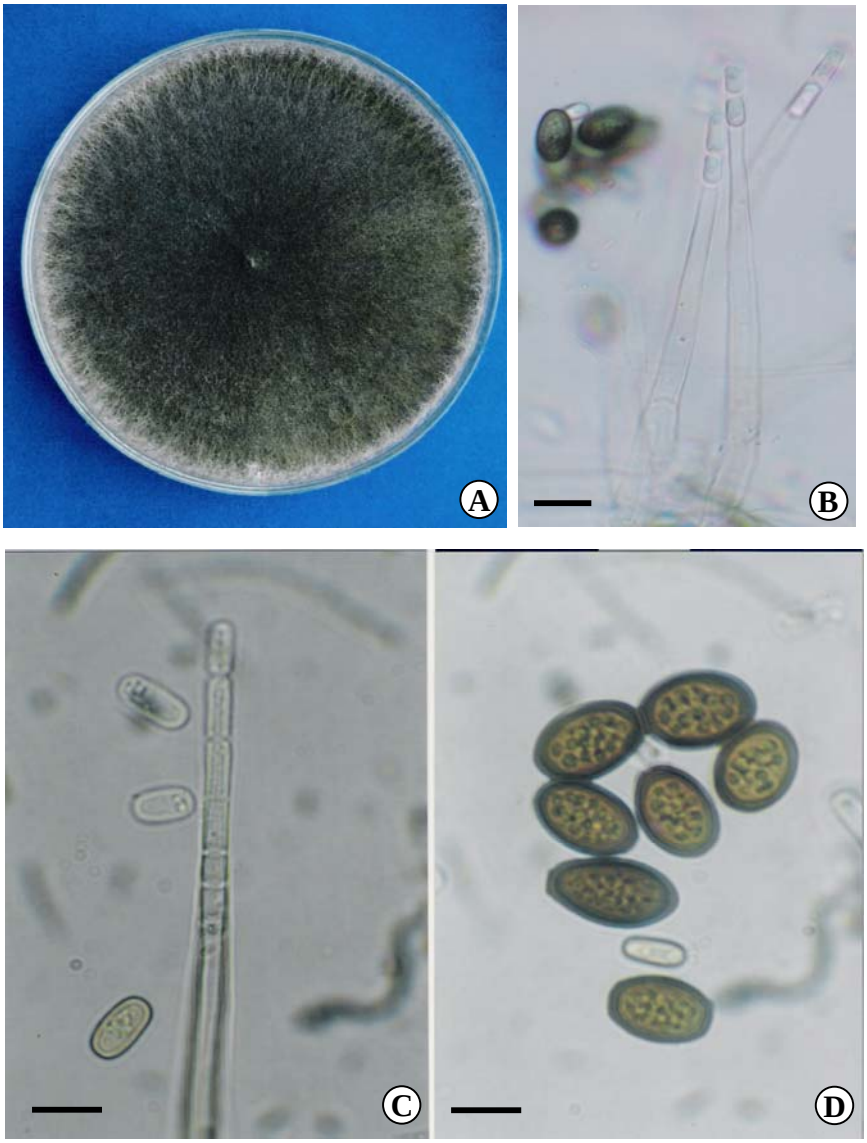


Figure 34 ***Thielaviopsis*** **state of** ***Ceratocystis paradoxa*** (Dade) C. Moreau (KUFC 3208) A. Colony on PDA, 14 days at 28 ^{o}C

B. Conidiophores, arthroconidia and phialoconidia

C. Phialide with phialoconidia

D. Arthroconidia (bars: B = 20 μm; C, D = 10 μm).

This fungus, in contrast to other *Trichoderma* species, is totally ineffective against *Armillaria mellea*. Antifungal activity of volatile and non-volatile metabolites from *T. hamatum* was reported (Domsch *et al*., 1993).

70. *Trichoderma harzianum* Rifai, 1969

Specimens examined: KUFC 3306, 3309 (barking); 3314 (buffalo); 3321 (camel); 3327, 3329 (cow); 3330 (deer); 3332, 3334 (elephant); 3335, 3337 (gaur); 3339 (goat;) 3342, 3345, 3347 (horse) and 3349 (toad)

Reference: Domsch *et al*. (1993)

Colonies on PDA, reaching 9 cm diam. in 7 days at 28 ^{o}C. Mycelium greyish green. Branches and phialides are particularly broad, 3.5-4 μm wide Conidia subglobose to short-oval, measuring 3-3.2 x 2.5-2.8 μm.

The fungus is common on soil and rhizosphere of various plants (Domsch *et al*., 1993). *T. harzianum* was reported as the biological agent against control various plant diseases caused by *Pythium aphanidermatum*, *Phytophthora* spp., *Rhizoctonia solani* and *Sclerotium rolfsii* in Thailand (Chamswarng and Tanangsnakool, 1996; Chamswarng *et al*., 2001). This fungus was reported to produce secondary metabolites such as azaphilone, harzianolide, butenolide, harzianopyridone (Vinale *et al*., 2006).

71. *Xylaria* sp. Hill ex Schrank, 1780

Specimens examined: KUFC 2859 (elephant)

Reference:

Colonies on PDA, reaching 5.0-5.5 cm diam. in 14 days at 28 ^{o}C. Mycelium white, with black concentric zonation and stroma anamorph.

72. *Zopfiella latipes* (N. Lundq) Malloch & Cain.,1971 (Figure 35)

Specimens examined: KUFC 2451 (deer)

Reference: Lundqvist (1972)

Colonies on CMA growing slowly, reaching 5.0-5.5 cm diam. in 14 days at 28 ^{o}C. Mycelium brown to dark brown, forming cleistothecia in 10-14 days. Cleistothecia dark brown, globose to subglobose, 300-500 x 200-400 μm (Figures 35 D, 35F). Asci 8-spored, cylindrical, 145-150 x 24-26 μm (Figure 35A). Ascospores broadly clavate and unequally two-celled, 19-23 x 14-16 μm for the upper cell, dark in color and 6-7 x 5-5.5 μm for the hyaline pedicel (Figures 35B, 35C, 35E, 35G).

Lundqvist (1972) reported *Tripterospora latipes* from soil in Copenhagen and from submerged wood in Maryland, USA. However, Malloch and Cain (1970) proposed *Zopfiella latipes* as the correct name for *Tripterospora latipes* Lundq. This fungus is a new record for Thailand.

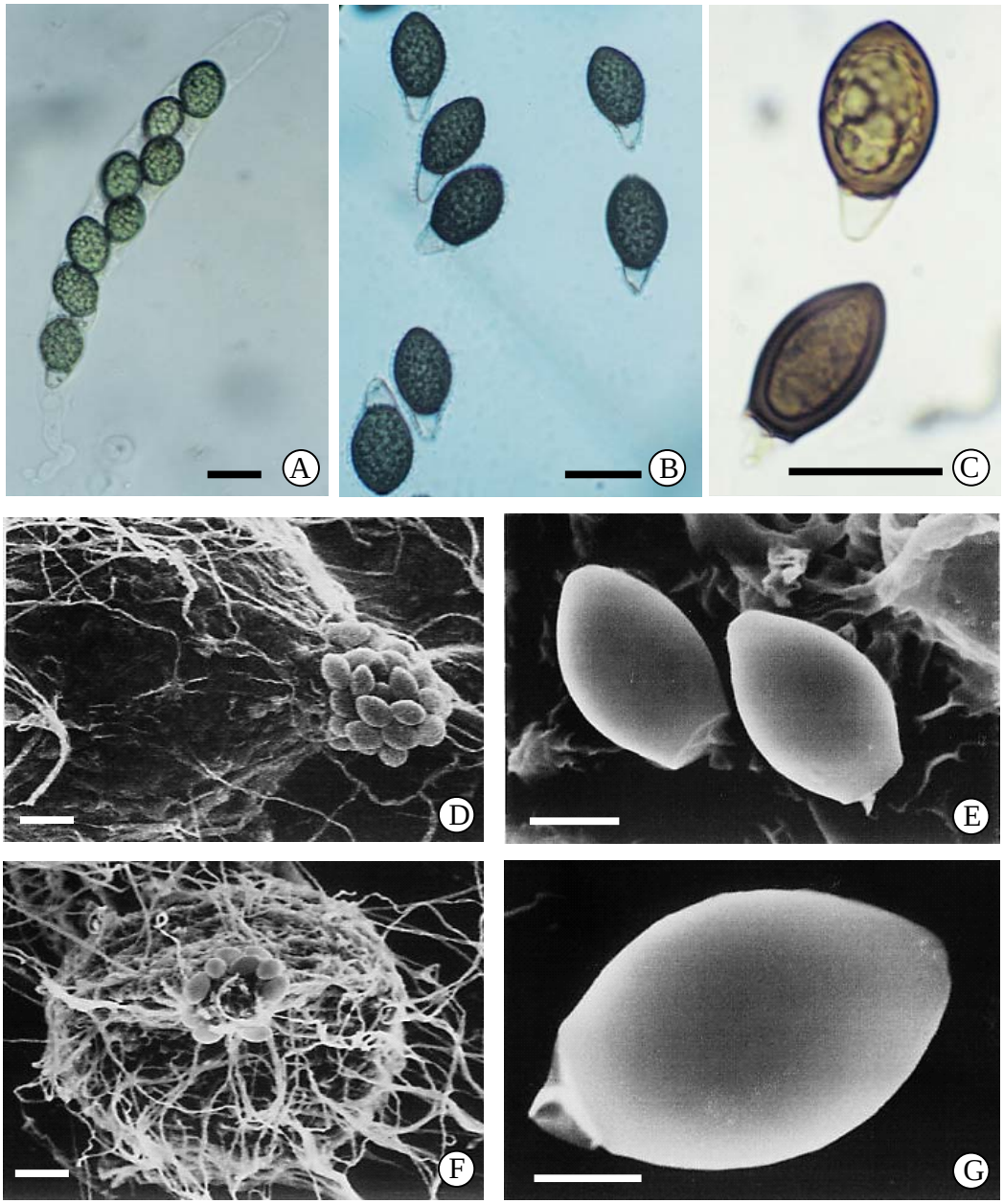


Figure 35 *Zopfiella latipes* (N. Lundq) Malloch & Cain. (KUFC 2541)
A-C. Ascus and ascospores, D- G. SEM photomicrographs of perithecia and ascospores (bars: A-C = 20 μm, D = 30 μm, E = 10 μm,F = 30 μm, G = 5 μm).

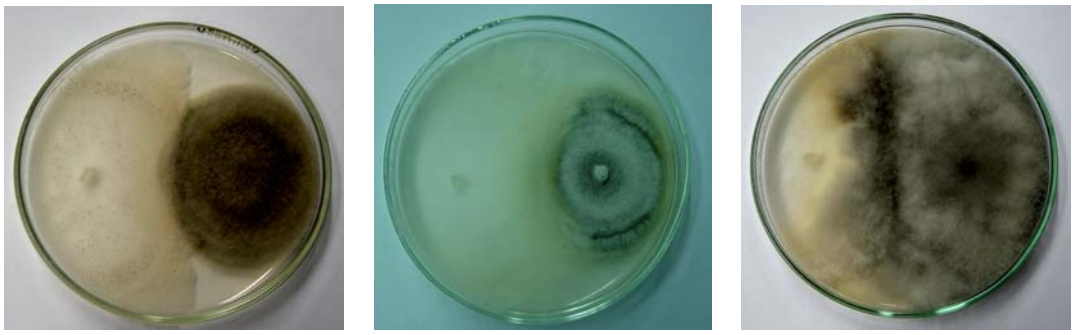
III. Antagonistic effect of *Ascodesmis macrospora* and *Sordaria fimicola* against plant pathogenic fungi

The results indicated that the three isolates of *Ascodesmis macrospora* including KUFC 2454, 2455 and 2456, showed moderate inhibit mycelial growth 40-50% for *Alternaria alternata*, *Colletotrichum capsici*, *Fusarium oxysporum* and *Pestalotiopsis guepinii.*, but all isolates failed to inhibit *Lasiodiplodia theobromae*, *Pythium aphanidermatum*, *Rhizoctonia solani* and *Sclerotium rolfsii* (Table 13, Figure 36).

Table 13 Percent inhibition on mycelial growth of nine plant pathogenic fungi by *Ascodesmis macrospora* cultivated on PDA in dual culture test at 28 ^{o}C for 14 days

Plant pathofenic fungi	Efficacy to inhibit mycelial growth of plant pathogenic fungi *in vitro*		
	KUFC 2454	KUFC 2455	KUFC 2456
Alternaria alternata	52.6	47.6	45.7
Colletotrichum capsici	48.7	45.0	43.6
Curvularia lunata	25.2	32.5	30.5
Fusarium oxysporum	50.2	49.5	52.5
Lasiodiplodia theobromae	0*	0*	0*
Pestalotiopsis guepinii	50.5	46.5	43.5
Pythium aphanidermatum	0*	0*	0*
Rhizoctonia solani	0*	0*	0*
Sclerotium rolfsii	0*	0*	0*

Remark: * plant pathogenic fungi overgrew the colony of *A. macrospora*



A. macrospora vs *A. alternata* *A. macrospora* vs *Col. capsici* *A. macrospora* vs *Cu. lunata*

A. macrospora vs *F. oxysporum* *A. macrospora* vs *L. threobromae* *A. macrospora* vs *P. guepinii*

A. macrospora vs *Py. aphanidermatum* *A. macrospora* vs *R. solani* *A. macrospora* vs *S. rolfsii*

Figure 36 Antagonistic activity test of *Ascodesmis macr*ospora KUFC 2456 (left) against nine species of plant pathogenic fungi (right) incubated as dual culture on PDA, 28 ^{o}C, 14 days.

Table 14 and Figure 38 indicated that the six isolates of *S. fimicola* can inhibit mycelial growth > 50% for *Alternaria alternata, Colletotrichum capsici, Curvalaria lunata* and *Pestalotiopsis guepinii.* However, percent inhibition differed among *S. fimicola* isolates, for example KUFC 2495, 2498, 2499 and 2504 effectively controlled *Fusarium oxysporum,* whereas KUFC 2498, 2499, 2503 and 2504 inhibited mycelial growth of *Lasiodiplodia theobromae*, but KUFC 2495 and 2496 failed to inhibit *L. theobromae*. Two isolates of KUFC 2496 and 2503 could inhibit mycelial growth of *Pythium aphanidermatum.* It is interesting to note that the six isolates of *S. fimicola* did not inhibit mycelial growth of two basidiomycete anamorphs, *Rhizoctonia solani* and *Sclerotium rolfsii*.

Table 14 Percent inhibition on mycelial growth of nine plant pathogenic fungi by *Sordaria fimicola* cultivated on PDA in dual culture test at 28 ^{o}C for 14 days.

Plant pathofenic fungi	**Efficacy to inhibit mycelial growth of plant pathogenic fungi *in vitro***					
	KUFC 2495	KUFC 2496	KUFC 2498	KUFC 2499	KUFC 2503	KUFC 2504
Alternaria alternata	50	66.7	60	66.7	66.7	76.7
Colletotrichum capsici	56.7	73.3	63.3	60	66.7	63.3
Curvularia lunata	51.4	65.7	68.6	62.9	71.4	57.1
Fusarium oxysporum	73.3	37.8	60	62	48.9	66.7
Lasiodiplodia theobromae	26.7	0	61	57.3	60	64
Pestalotiopsis guepinii	76	80	78	76	74	76
Pythium aphanidermatum	30.7	57.3	40	36	49	0*
Rhizoctonia solani	0*	0*	2.7	0*	6.7	0*
Sclerotium rolfsii	6.7	0*	4	6.7	4	0*

Remark: * plant pathogenic fungi overgrew the colony of *S. fimicola*

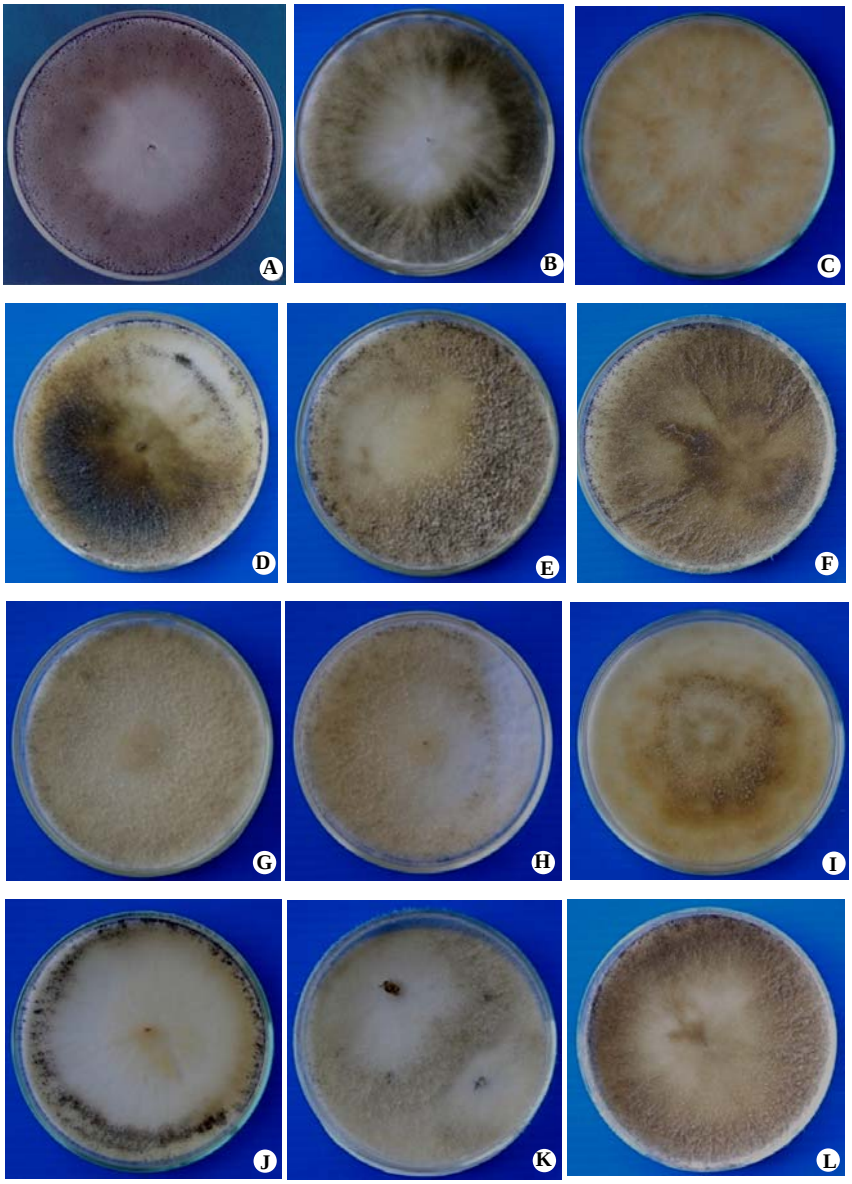


Figure 37 Colonies of different isolates of *Sordaria fimicola* on PDA at 28 ^{o}C, 7 days, A. KUFC 2495, B. KUFC 249, C. KUFC 2497, D. KUFC 2498, E. KUFC 2499, F. KUFC 2502, G. KUFC 2503, H. KUFC 2504, I. KUFC 2505, J. KUFC 2507, K. KUFC 2509, L. KUFC 2510.

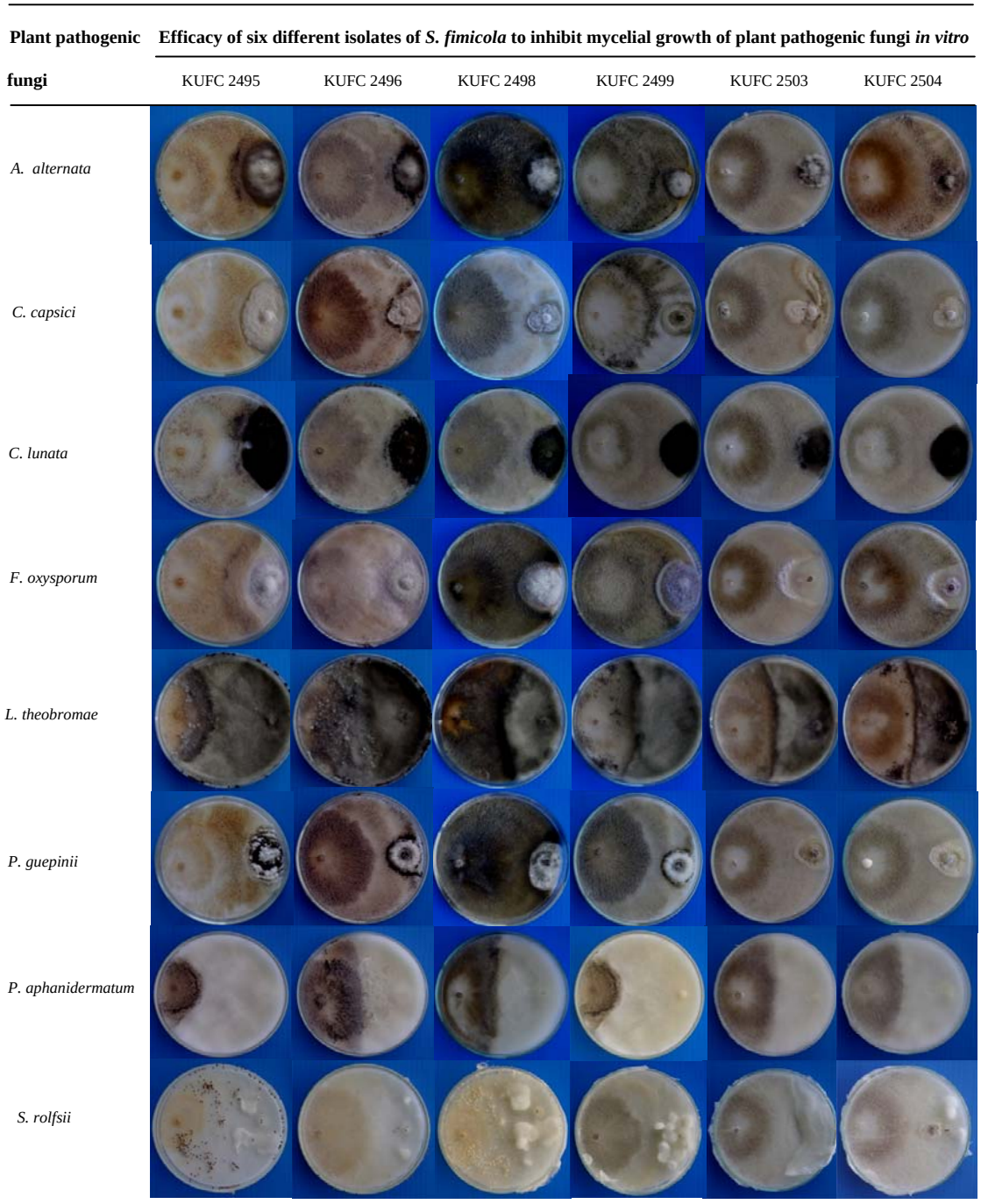


Figure 38 Antagonistic activity test of six isolates of *Sordaria fimicola* (left) against eight species of plant pathogenic fungi (right) incubated as dual culture on PDA, 28 ^{o}C, 14 days.

S. fimicola was recorded as an antagonistic fungus against soil-borne plant diseases caused by *Pythium aphanidermatum* and *Dematophora necatrix* in Japan (Watanabe, 1991). However, in our study, only two isolates of *S. fimicola* moderately inhibited mycelial growth of *P. aphanidermatum*.

In Australia, Dewan et al. (1994) reported that *S. fimicola* isolated from wheat and rye-grass roots promoted the growth of the host plants and reduce take-all disease. They also stated that the occurrence of *S. fimicola* was more frequent at the seedling stage of plant growth. In sterilized and non-sterilized soil, *S. fimicola* promoted plant growth and also reduced the mortality of both hosts after inoculation with the take-all fungus (*Gaeumannomyces graminis* var. *tritici*). Two compounds, triacontanol and indole-3-carboxaldehyde, were isolated from potato dextrose broth cultures of *S. fimicola* enhancing the plant growth. They concluded that the fungus can produce indole acetic acid (IAA) and that IAA and triacontanol contribute to growth promotion and the reduction of disease. Therefore it would be interesting for further studies to search for novel bioactive compounds of *S. fimicola* for growth promotion of the host plant and to reduce plant diseases caused by fungi.

IV. Secondary metabolites from *Ascodesmis macrospora* and *Sordaria fimicola*

1. Secondary metabolites from *Ascodesmis macrospora*

Crude extract of *Ascodesmis macrospora* was isolateed and purified the secondary metabolites comprising 3 compounds from 8 fractions including:

Fractions AMC 3 (30.4 mg) were purified by preparative TLC (Petrol-$CHCl_3$- HCO_2H, 1: 9: 0.1%) to give yellow liquid of **3-keto derivative of ergosterol** (23.8 mg) (Figure 39)

Fractions AMC 4 (68.2 mg) were purified by precipitate crystals with $CHCl_3$ to give white crystals of the mixture of **ergosterol** and **7,8-dehydroergosterol** (52.7 mg) (Figure 40)

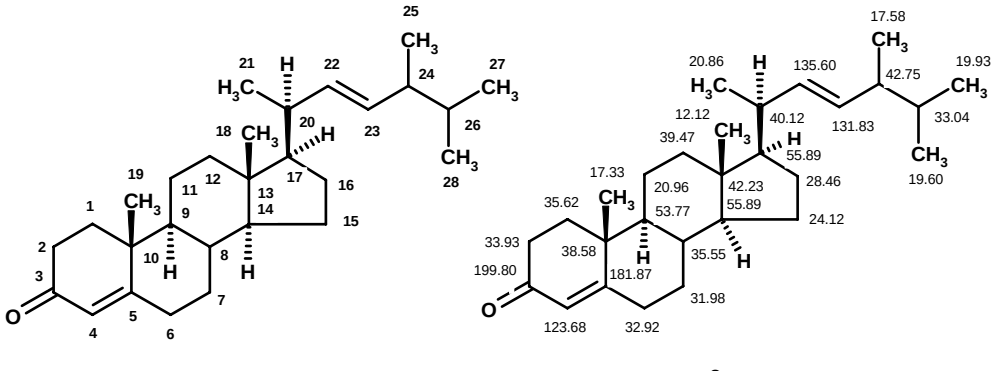
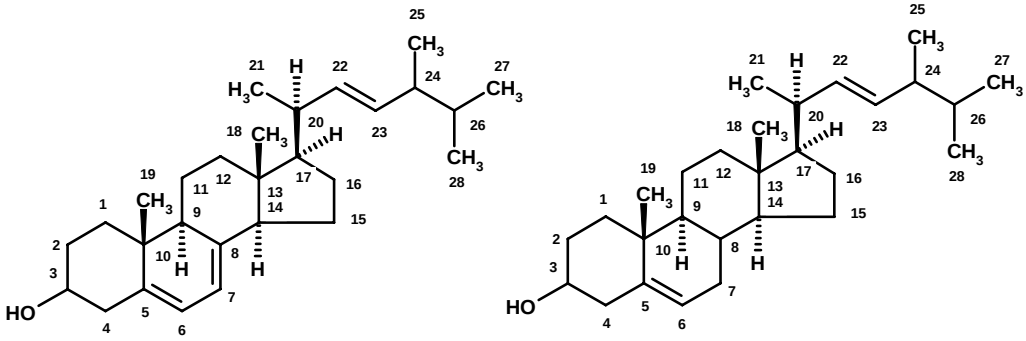


Figure 39 Chemical structures of 3-keto derivative of ergosterol

Ergosterol, 7,8-dehydroergosterol and its 3-keto derivative were isolated from the crude extract of *Ascodesmis macrospora*. Their structures were established by analysis of ^{1}H, ^{13}C NMR as well as COSY, HSQC, HMBC spectra as well HRMS.



ergosterol 7,8-dehydroergosterol

Figure 40 Chemical structures of ergosterol and 7,8-dehydroergosterol

2. Secondary metabolites from *Sordaria fimicola*

Crude extract of *Sordaria fimicola* was isolated and purified the secondary metabolites comprising 1 compounds of parahydroxy paradehye.

Fractions SFC 9-13 (88.7 mg) were purified by preparative TLC ($CHCl_3$-$(CH_3)_2CO$ - HCO_2H, 9.3:7: 0.1%) to give yellow liquid of **parahydroxy paradehye** (28.5 mg)**.**

Table 15 ^{13} NMR data ($CDCl_3$, 75.47 MHz) of 3-keto derivative of ergosterol

C	δ ^{13}C	δ ^{1}H (HSQC)
1	35.62 CH_2	1.61-1.75 *m*; 1.48-1.58 *m*
2	33.93 CH_2	2.30-2.50 *m*
3	199.80 CO	-
4	123.68 CH	5.73 *brs*
5	171.87 C	-
6	32.92 CH_2	2.19-2.44 *m*
7	31.98 CH_2	0.97-1.04 *m*; 1.80-1.88 *m*
8	35.55 CH	1.98-2.00 *m*
9	53.77 CH	0.87-0.97 *m*
10	38.58 C	-
11	20.96 CH_2	1.40-1.88 *m*
12	39.47 CH_2	1.08-1.22 *m*
13	42.23 C	-
14	55.89 CH	0.94-1.17 *m*
15	24.12 CH_2	1.04-1.20 *m*; 1.52-1.65 *m*
16	28.46 CH_2	1.64-1.74 *m*
17	55.89 CH	0.94-1.17 *m*
18	12.12 CH_3	0.72 *s*
19	17.33 CH_3	1.18 *s*
20	40.12 CH	1.95-2.10 *m*
21	20.86 CH_3	1.00 *d* (J = 6.6)
22	135.60 CH	5.14 *dd* (J = 15.0, 7.1)
23	131.83 CH	5.22 *dd* (J = 15.0, 6.9)
24	42.75 CH	1.80-1.86 *m*
25	17.58 CH_3	0.91 d (J = 6.9)
26	33.04 CH	1.40-1.58 *m*
27	19.93 CH_3	0.84 d (J = 6.6)
28	19.60 CH_3	0.82 d (J = 6.7)

Table 16 ^{13} NMR data ($CDCl_3$, 75.47 MHz) of ergosterol

C	δ ^{13}C	δ ^{1}H (HSQC)
1	38.33 CH_2	-
2	31.89 CH_2	-
3	70.39 CH	3.63 *m*
4	42.20 CH_2	-
5	140.69 C	-
6	119.55 CH	5.54 *dd* (J = 5.6, 2.3)
7	116.26 CH	5.37 *dd* (J = 5.1, 2.9)
8	141.30 C	-
9	46.19 CH	-
10	36.97 C	-
11	21.03 CH_2	-
12	39.04 CH_2	-
13	42.18 C	-
14	54.51 CH	-
15	22.96 CH_2	-
16	28.27 CH_2	-
17	55.67 CH	-
18	12.01 CH_3	0.60 *s*
19	16.23 CH_3	0.92 *s*
20	40.41 CH	-
21	21.06 CH_3	0.99 *d* (J = 5.4)
22	135.53 CH	5.21 *dd* (J = 16.0, 6.6)
23	131.92 CH	5.21 *dd* (J = 16.0, 6.6)
24	42.77 CH	-
25	17.58 CH_3	0.89 *d* (J = 6.9)
26	33.04 CH	-
27	19.61 CH_3	0.79 *d* (J = 5.0)
28	19.92 CH_3	0.83 *d* (J = 5.0)

Table 17 ^{13}NMR data ($CDCl_3$, 75.47 MHz) of 7,8-dehydroergosterol

C	**δ ^{13}C**	**δ ^{1}H (HSQC)**
1	37.20 CH_2	-
2	31.55 CH_2	-
3	71.75 CH	3.50 *m*
4	42.20 CH_2	-
5	139.74 C	-
6	121.67 CH	5.33 *dd* (J = 4.7, 1.8)
7	39.63 CH_2	-
8	31.84 CH	-
9	50.10 CH	-
10	36.46 C	-
11	21.03 CH_2	-
12	39.63 CH_2	-
13	42.18 C	-
14	56.79 CH	-
15	24.24 CH_2	-
16	28.51 CH_2	-
17	55.95 CH	-
18	12.10 CH_3	0.66 *s*
19	19.36 CH_3	0.97 *s*
20	40.14 CH	-
21	20.92 CH_3	1.00 *d* (J = 6.6)
22	135.79 CH	5.12 *dd* (J = 15.6, 5.5)
23	131.67 CH	5.12 *dd* (J = 15.6, 5.5)
24	42.77 CH	-
25	17.58 CH_3	0.88 *d* (J = 6.8)
26	33.04 CH	-
27	19.61 CH_3	0.78 *d* (J = 5.0)
28	19.92 CH_3	0.81 *d* (J = 5.0)

Ergosterol is a main sterol of most higher fungi whose major function is stabilization of eukaryotic membrane. Generally, the occurrence of ergosterol is restricted to the more advanced fungal taxa while the more ones contain other sterols. Thus, it is the major sterol in Ascomycetes and Basidiomycetes. By contrast, it is rather more complex within the Zygomycetes since members of Mucorales contain ergosterol, while Mortierellaceae contain desmosterol, but no ergosterol (Weete and Gandhi, 1999). In the same way, most members of the newly identified phylum Glomeromycota, fungal obligate symbionts forming arbuscular mycorrhiza, seem to contain sterols other than ergosterol (Schussler *et al*., 2001; Hart and Reader, 2002).

Moreover, halotolerant and halophilic melanized fungi such as *Alternaria alternata*, *Cladosporium sphaerospermum*, *Cladosporium* sp., and *Aureobasidium pullulans*, were described the dominance of ergosterol composition and the presence of 29 intermediates of its biosynthesis pathway (Mejanelle *et al*., 2001).

Ergosterol has been reported to be a biomarker to estimate the fungal biomass in soil, pathogenic fungi in roots , fungi in cereal grain, saprophytic fungi in decaying plant material and ectomycorrhizal fungi in roots and soil (Ek *et al*., 1994; Ekblad *et al*., 1995; Frostegard and Baath, 1996; Wallander *et al*., 1997; Olsson *et al*., 2003).

Besides, ergosterol has been found to be a useful indicator for fungal biomass in polluted soils, and can be applied for monitoring bioremediation process as well as for studying biodegradation test of fungicides (chlorothalonil and propiconazole) by ectomycorrhiza fungi in soil (Barajas-Aceves *et al*. 2002).

Ultimately, it is noteworthy to point out that ergosteral is the biological precursor for Vitamin D_2. When exposed to the ultraviolet light, it is transformed into viosterol with a consequent conversion into ergocalciferol, which is a form of Vitamin D_2 (Granado *et al*., 1995).

CONCLUSION

Seventy hundred and five microfungi were isolated from 60 dung samples of 13 wildlife and domestic animals from 18 provinces, comprising 57 genera 69 species. Four hundred and six isolates of Hyphomycetes (57.6 %) were found, comprising 24 genera, 28 spp., followed by 182 isolates of Ascomycetes (25.8 %), 19 genera, 27 spp. ; 54 isolates of Agonomycetes (7.7 %), 2 genera, 2 spp. ; 41 isolates of Zygomycetes (5.8 %), 7 genera, 7 spp. ; 22 isolates of Coelomycetes (3.1 %), 4 genera, 4 spp. and one Basidiomycetes. The distribution is more frequent in the central part, but the fungi were found at different latitudes. They were dominant on cow dung (190 isolates) followed by elephant (94), buffalo (83), deer (60), rat and goat (42).

Nineteen genera and 27 species of Ascomycetes were identified comprising 6 genera, 12 species of Plectomycetes (31.6%); 10 genera, 11 species of Pyrenomycetes (52.6%) and 3 genera, 4 species of Discomycetes (15.8%). All taxa were cultivated on PDA and CMA, except *Podosordaria leporina* and *Saccobolus glaber* which failed to grow on agar media. Among them, *Ascobolus albidus*, *Ascodesmis macrospora*, *A. sphaerospora*, *Cercophora silvatica*, *Gelasinospora brevispora*, *Podosordaria leporina*, *Podospora curvicolla*, *Saccobolus glaber* and *Zopfiella latipes* were found on only one type of dung. The most common species were *Chaetomium globosum*, *Sordaria fimicola* and *Sporormiella minima*. The diversity of coprophilous fungi depends on the type and number of dung samples, habitats, collecting sites and isolation techniques used.

Ascomycetes were mostly found on cow dung, and 43 isolates were recorded followed by deer and elephant (20 isolates), rat (17), buffalo (15), goat (13), toad (11)

and rabbit (10). The moist chamber method yielded the highest number of coprophilous Ascomycetes, followed by the soil plate method, alcohol treatment, heat treatment and dilution plate method.

Nothworthy Ascomycetes representing new records for Thailand are *Ascobolus albidus*, *Ascodesmis sphaerospora*, *Cercophora silvatica*, *Gelasinospora brevispora*, *Podosordaria leporina*, *Sporormiella minima*, and *Zopfiella latipes*.

Hyphomycetes most frequently occurred on cow dung among domestic animals and elephant dung for wild animals. The moist chamber, soil plate and dilution plate methods yielded the highest number of species of Hyphomycetes, whilst alcohol and heat treatment methods showed the fewer species. Five taxa including *Nigrospora oryzae*, *Nodulisporium gregarium*, *Oidiodendron griseum*, *Stachybotrys atra* and *Thielaviopsis* state of *Ceratocystis paradoxa* were found on only one type of dung. All taxa could be cultivated on artificial media.

Interesting species of Hyphomycetes representing new records for Thailand are *Nodulisporium gregarium*, *Oidiodendron griseum* and *Pithomyces karoo.* Coprophilous Hyphomycetes are *Arthrobotrys oligospora*, *Aspergillus candidus*, *Cephaliophora irregularis* and *Oidiodendron griseum*.

Four genera and 4 species of Coelomycetes were found on various dung samples, including *Chaetomella raphigera*, *Colletotrichum gloeosporioides*, *Lasiodiplodia theobromae* and *Pestalotiopsis guepinii*. They occurred at high frequency on cow dung (7 isolates), followed by buffalo (5), eld's deer (3), barking deer, horse (2), gaur, goat and rabbit (1).

Papulaspora immersa was the most common species of Agonomycetes on dung samples. Eighteen isolates were found on cow dung followed by buffalo (15 isolates), elephant (10), goat (4), deer (3), rat (2), eld's deer and gaur (1), whilst only one species of *Rhizoctonia* was found on cow dung. One species of *Coprinus* (Basidiomycete) was found on elephant dung, but this fungus failed to grow on agar media.

Antagonistic activity tests of selected coprophilous fungi against nine plant pathogenic fungi *in vitro* indicated that three isolates of *Ascodesmis macrospora* (KUFC 2454, 2455 and 2456) showed moderate inhibit mycelial growth 40-50% for *Alternaria alternata, Colletotrichum capsici, Fusarium oxysporum* and *Pestalotiopsis guepinii.*, but all isolates failed to inhibit *Lasiodiplodia theobromae*, *Pythium aphanidermatum*, *Rhizoctonia solani* and *Sclerotium rolfsii*

Six isolates of *S. fimicola* (KUFC 2495, 2496, 2498, 2499, 2503 and 2504) inhibited mycelial growth > 50% for *Alternaria alternata*, *Colletotrichum capsici*, *Curvularia lunata* and *Pestalotiopsis guepinii.* However, percent inhibition differed among *S. fimicola* isolates, for example KUFC 2495, 2498, 2499 and 2504 effectively controlled *Fusarium oxysporum,* whereas KUFC 2498, 2499, 2503 and 2504 inhibited mycelial growth of *Lasiodiplodia theobromae*, but KUFC 2495 and 2496 failed to inhibit *L. theobromae*. *S. fimicola* (KUFC 2496 and 2503) could inhibit mycelial growth of *Pythium aphanidermatum*. It is interesting to note that the six isolates of *S. fimicola* did not inhibit mycelial growth of two basidiomycete anamorphs, *Rhizoctonia solani* and *Sclerotium rolfsii*.

For secondary metabolites investigation, ergosterol, 7,8-dehydroergosterol and a 3-keto derivative of ergosterol were isolated from *Ascodesmis macrospora* and parahydroxy paradehyde was isolated from *Sordaria fimicola*.

LITERATURE CITED

Adamonyte, G. 2003. *Trichia papillata*, a new coprophilous myxomycete species. **Mycotaxon** 87: 379-384.

Ahmed, S.I. and R.F. Cain. 1972. Revision of the genera *Sporormia* and *Sporormiella*. **Can. J. Bot.** 50: 419-477.

Alfatafta, A.A., J.B. Gloer, J.A. Scott and D. Malloch. 1994. Apiosporamide: a new antifungal agent from coprophilous fungus *Apiospora montagnei*. **J. Nat. Prod.** 57: 1696-1699.

Ames, L.M. 1969. **A Monograph of The Genus *Chaetomiaceae***. Stechert-Hafner Survice Agency, Inc.: New York.

Arx, J.A. von, J. Guarro and M.J. Figueras. 1986. The ascomycete genus *Chaetomium*. **Beih. Nova Hedwigia** 84: 1-162.

Barajas-Aceves, M, M. Hassan, R. Tinoco and R. Vazquez-Duhalt. 2002. Effect of pollutant on the ergosterol content as indicator of fungal biomass. **J. Microbiol. Methods.** 50(3): 227-236.

Barnett, H.L. and B.B. Hunter. 1998. **Illustrated Genera of Imperfect Fungi**. The American Phytopathological Society, Minnesota. 218 p.

Barr, M.E. 2000. Notes on coprophilous bitunicate Ascomycetes. **Mycotaxon** 76: 105-112.

Barron, G.L. 1968. **The Genera of Hyphomycetes from Soil**. The Williams & Wilkins Company, Baltimore.

Bell, A. 1983. **Dung Fungi an Illustrated Guide to Coprophilous Fungi in New Zealand**.Victoria Univ. Press, Wellington.

Bell, A. 2005. **An Illustrated Guide to the Coprophilous Ascomycetes of Australia.** Biodiversity Series 3. Centraalbureau voor Schimmelcultures, Utrecht. The Natherlands.

Bell, A. and D.P. Mahoney. 1995. Coprophilous fungi in New Zealand I. *Podospora* species with swollen agglutinated perithecial hairs. **Mycol.** 83: 375-396.

Bell, A. and D.P. Mahoney. 1996. Perithecium development in *Podospora tetraspora* and *Podospora vesticola*. **Mycol.** 88: 163-170.

Bennett, J.W. and M. Klich. 2003. Mycotoxins. **Clin. Microb. Rev.** 16(3): 497-516.

Cain, R.F. 1934. Studies of coprophilous Sphaeriales in Ontario. **Univ. Toronto Study Bio. Series**. 38: 1-126.

Cain, R.F. 1956. Studies of coprophilous ascomycetes IV. *Tripterospora*, a new cleistocarpous genus in a new family. **Can. J. Bot.** 34: 699-710.

Cain, R.F. 1968. **Studies of Coprophilous Sphaeriales in Ontario**. Verlag Von J. Cramer, Germany.

Cain, R.F. and J.H. Mirza. 1970. *Apodospora*, a new genus of the Sordariaceae. **Can. J. Bot.** 48: 891-896.

Carmichael, J.W., W. Bryce Kendrick, I.L. Conners and L. Sigler. 1980. **Genera of Hyphomycetes.** The University of Alberta Press, Edmonton.

Chamswarng, C. and C. Tanangsnakool. 1996. UNIGREEN UN-1^{R} (*Trichoderma harzianum*): The first registered biofungicide in Thailand. *In* **Proceeding of the International Symposium on Biopesticides**. Pitsanulok, Thailand. October 27-31, 1996.

Chamswarng, C., W. Intanoo and T. Kumchang. 2001. Efficacy of various formulations of *Trichoderma harzia*num for controlling stem rot of yard long bean caused by *Sclerotium rolfsii*. *In* **Proceedings of the 39th Kasetsart University Annual Conference**. Kasetsart University, Bangkok, Thailand.

Chandramohan , S. and R. Charudattan. 2001. Control of seven grasses with a mixture of three fungal pathogens with restricted host ranges. **Bio. Cont.** 22: 246-255.

Chang, J. H. and Y. Z. Wang. 2005. A new species of *Podospora* from Taiwan. **Bot. Bull. Acad. Sin.** 46: 169-173.

Che, Y., D.C. Swenson, J.B. Gloer, B. Koster and D. Malloch. 2001. Pseudodestruxins A and B : new cyclic depsipeptides from the coprophilous fungus *Nigrosabulum globosum*. **J. Nat. Prod.** 64: 555-558.

De Hoog, G.S., J. Guarro, J. Gene and M.J. Figueras. 2000. **Atlas of Clinical Fungal**. 2nd Ed. Centraalbureau voor Schimmelcultures, Utrecht, The Netherlands.

Delgado, A.E., J.W. Kimbrough and R.T. Hanlin. 2000. *Zygopleurage zygospora*, a new record from Venezuela. **Mycotaxon**. LXXV: 257-263.

Dethoup, T., L. Manoch, N. Visarathanonth, C. Chamswarng, S. Chawpongpang, S. To-Anun and A. Kijjoa. 2007. Diversity of *Talaromyces* from soils and their effects on plant pathogenic fungi *in vitro*. pp. 563-570. *In* **Proceedings of 45th Kasetsart University Annual Conference (Plants).** Kasetsart University, Bangkok.

Dewan, M.M., E.L. Ghisalberti, C. Rowland and K. Sivasithamparam. 1994. Reduction of symptom of take-all of wheat and ryegrass seedlings by the soil-borne fungus *Sordaria fimicola*. **Appl. Soil Eco.** 1: 45-51.

Dickinson, C.H. and V.H.S. Underhay. 1977. Growth of fungi in cattle dung. **Trans. Brit. Mycol. Soc.** 69: 473-477.

Dokmetzian, D.A. and M.E. Ranalli. 2002. A. natural mutant of *Ascobolus michaudii* (Ascomycotina, Pezizales). **Mycotaxon** 81: 243-249.

Domsch, K.H., W. Gams and Anderson. 1993. **Compendium of Soil Fungi.** Vol. 1, 2nd ed. Academic Press, London.

Ebersohn, C. and A. Eicker. 1997. Determination of the coprophilous fungal fruit body successional phases and the delimination of species association classes on dung substrates of Africa game animal. **Bot. Bull. Aca. Sin**. 38: 183-190.

Ek, M., M. Sjogren, K. Arnebrant and B. Soderstrom. 1994. Extramatricel mycelial growth, biomass allocation and nitrogen uptake in ectomycorrhizal systems in response to collembolan grazing. **Appl. Soil Eco.** 1: 155-169.

Ekblad A., H. Wallander, R. Carlsson and K. Huss-Danell. 1995. Fungal biomass in roots and extramatrical mycelium in relation to macronutrients and plant biomass of ectomycorrhizal *Pinus sylvestris* and *Alnus incana*. **New Phytologist** 131: 443-451.

Ellis, M.B. 1971. **Dematiaceous Hyphomycetes**. Commonwealth Mycological Institute, Kew, Surry.

_____. 1976. **More Dematiaceous Hyphomycetes**. Commonwealth Mycological Institute, Kew, Surry.

Ellis, M.B. and J.P. Ellis. 1998. **Microfungi on Miscellaneous Substrates: an identification handbook**. 2nd edn. Richmond Publishing: Slough.

Elshafie, A.E. 2005. Coprophilous mycobiota of Oman. **Mycotaxon** 93: 355-357.

Feng-Qin, L., T. Noritsuna and Y. Takumi. 2001. Production of Alternaria mycotoxins by *Alternaria alternata* isolated from weather-damaged wheat. **J. Food Protec.** 64: 567-571.

Fong, Y.K., S. Anuar, H.P. Lim, F.Y. Tham and F.R. Sanderson. 2000. A modified filter paper technique for long-term preservation of some fungi cultures. **Mycologist** Vol. 14, Part 3, August.

Frisvad, J.C., P.D.Bridge and D.K. Arora. 1998. **Chemical Fungal Taxonomy**. Marcel Dekker, Inc. USA. 398 p.

Frostegard A and E. Baath. 1996. The use of phospholipid fatty acid analysis to estimate bacterial and fungal biomass in soil. **Bio. Fer. Soils** 22: 59-65.

Gamble, W.R., J.B. Gloer, J.A. Scott and D. Malloch. 1995. Polytolypin: a new antifungal triterpenoid from the coprophilous fungus *Polytolypa hystricis*. **J. Nat. Prod.** 58: 1983-1986.

Gloer, J.B. and Truckenbrod, S.M. 1988. Interference competition among coprophilous fungi: production of (+)-isoepoxydon by *Poronia punctata*. **Appli. Envi. Micro.** 54: 861-864.

Gochenaur, S. 1964. A modification of the immersion tube method for isolating soil fungi. **Mycologia** 56: 921-923.

Granado, J., G. Felix and T. Boller. 1995. Perception of fungal sterols in plants. **Plant Physiol.** 107: 485-490.

Hanlin, R.T. 1998. **Illustrated Genera of Ascomycetes**. The American Phytopathological Society, Minnesota.

Hart, M.M. and R.J. Reader. 2002. Taxonomic basis for variation in the colonization strategy of arbuscular mycorrhizal fungi. **New Phytologist.** 153: 335-344.

Hein, S.M., J.B. Gloer, B. Koster and D. Malloch. 2001. Bombardolides : new antifungal and antibacterial metabolites from the coprophilous fungus *Bombardioidea anartia*. **J. Nat. Prod.** 64: 809-812.

Hein, S.M., J.B. Gloer, J.A. Scott, and D. Malloch. 1998. Arugosin F: a new antifungal metabolite from the coprophilous fungus *Ascodesmis sphaerospora*. **J. Nat. Prod.** 61: 1566-1567.

Hennebert, G.L. 2005. Diagnosis and variability of coprophilous *Basifimbria aurea*. **Mycol. Res.** 109(5): 595-602.

Houbraken, J., J.C. Frisvad and R.A. Samson. 2006. Sporidesmin production by *Pithomyces*. p. 30. *In* **Abstracts of the Fungi and Mycotoxins in Food and Indoor Air. A Joint Symposium of ICFM and ICIF at the 8th International Mycological Congress**, Cairns, Australia.

Intana, W., C. Chamswarng, W. Intanoo, C. Hongprayoon and K. Sivasithamparam. 2003. Use of mutant strains for improved efficacy of *Trichoderma harzianum* for controlling cucumber damping-off. **Thai J. Agric. Sci.** 36(4): 429-439.

Isaka, M., J. Punya, Y. Lertwerawat, M. Tanticharoen and Y. Thebtaranonth. 1999. Antimalarial Activity of macrocyclic trichothecenes isolated from the fungus *M. verrucaria*. **J. Nat. Prod.** 62(2): 329-331.

Jaffee, B.A. 2004. Wood, nematodes and the nematode-trapping fungus *Arthrobotrys oligospora*. **Soil Bio. Biochem.** 36: 1171-1178.

Jeng, R.S. and J.C. Krug. 1977. New records and new species of coprophilous Pezizales from Argentina and Venezuela. **Can. J. Bot.** 55: 2987-3000.

Ju, Y.-M. and Roger, J.D. 1996. **A Revision of the Genus Hypoxylon**. Mycologia Memoir No. 20. APS Press, St Paul, Minnesota. U.S.A.

Kanokmedhakul, S., K. Kanokmedhakul, N. Phonkerd, K. Soytong, K., P. Kongsaeree and A. Suksamrarn. 2002. Antimycobacterial anthraquinone-chromanone compound and diketopiperazine alkaloid from the fungus Chaetomium globosum KMITL-N0802. **Planta Medica.** 68: 832-836.

Kanokmedhakul, S., K. Kanokmedhakul, K. Soytong, K.and A. Suksamrarn. 2004. Bioactive compounds from *Chaetomium cupreum, C. globosum* and *Trichoderma harzianum*. pp. 166-169. *In* **Proceeding of the 1st KMITL**

International Conference on Integration of Science and Technology for Sustainable Development. Bangkok, Thailand. Vol. 2.

Khan, R.S. and J.C. Krug.1989. New species of *Gelasinospora*. **Mycologia** 81(2): 226-233.

Khan, R.S. and R.F. Cain. 1972. Five new species of *Podospora* from East Africa. **Can. J. Bot.** 50: 1649-1661.

Kirk, P.M., P.F. Cannon, J.C. David and J.A. Stalpers. 2001. **Ainsworth and Bisby's Dictionary of the Fungi**. 9th edition, CAB. Publishing, UK.

Klick, M.A. 2002. **Identification of Common *Aspergillus* Species.** Centraalbureau voor Schimmelcultures. Wageningen, The Netherlands.

Krug, J.C. and R.F. Cain. 1974. A preliminary treatment of the genus *Podosordaria*. **Can. J. Bot.** 52: 589-605.

Krug, J.C. and R.S. Khan. 1991. *Dictyocoprotus*, a new genus of the pyronemataceae with reticulated ascospores. **Mycologia** 83: 103-106.

Kuwahara, S. and M. Enomoto. 2005. Enantioselective synthesis and stereochemical revision of communiols A-G. **Tetrahedron Lett.** 46: 6297-6300.

Lamb, B.C., M. Saleem, W. Scott, N. Thapa and E. Nevo. 1998. Inherited and environmentally induced difference in mutation frequencies between wild strains of *Sordaria fimicola* from "Evolution Canyon". **Genetics** 149: 87-99.

Langley, D. 1997. Exploiting the fungi: novel leads to new medicines. **The Mycologist** 11: 165-167.

Lee, K.K., J.B. Gloer, J.A. Scott and D. Malloch. 1995. Petriellin A: A noval antifungal depsipeptide from the coprophilous fungus *Petriella sordida*. **J. Org. Chem.** 60: 5384-5385.

Logrieco, A., A. Bottalico, G. Mule, A. Moretti and G. Perrone. 2003. Epidemiology of toxigenic fungi and their associated mycotoxins for some mediterranean crops. **Euro. J. Plant Patho.** 109(7): 645-667.

Lundqvist, N. 1972. **Nordic Sordariaceae s. lat. in Symbolae Botanicae Upsaliensee**, **20(1).** University of Uppsala, Sweden.

Lundqvist, N., D.P. Mahoney, A. Bell and L.E. Lorenzo. 1999. *Podospora austrohemisphaerica*, a new heterthallic ascomycete from dung. **Mycologia** 91: 405-415.

Madi, L., T. Katan, J. Katan and Y. Henis. 1997. Biological control of *Sclerotium rolfsii* and *Verticillium dahliae* by *Talaromyces flavus* is mediated by different mechanism. **Phytopath**. 87(10): 1054-1060.

Mai, S.H. 1977. Mophological studies in *Sordaria fimicola* and *Gelasinospora longispora*. **Am. J. Bot.** 64(5): 489-495.

Malloch, D and R.F. Cain. 1971. New cleistothecial Sordariaceae and a new family, Coniochaetaceae. **Can. J. Bot.** 49: 869-880.

Manoch, L. 2000. Fungi. pp. 219-246. *In* **Review of Biodiversity Research in Thailand. Biodiversity Research and Training Programe (BRT)**, Bangkok, Thailand.

Manoch, L., C. Chana and P. Athipunyakom. 1999. Diversity of coprophilous fungi in Thailand. pp. 675-688. *In* **Abstracts of International Conference on Asean Network on Microbial Research**, Chiang Mai, Thailand.

Manoch, L., C. Chana and P. Athipunyakom. 2000a. Microfungi from different forest types of Huay Kha Khang Wildlife Sanctuary. pp. 436-444. *In* **Proceedings of 38th Kasetsart University Annual Conference.** Bangkok. Thailand.

Manoch, L., C. Chana, P. Athipunyakom and A. Somrith. 2000b. Noteworthy Ascomycota from Thailand, with Special Emphasis on Coprophilous Pyrenomycetes and Discomycetes. p. 23. *In* **Abstracts of the BMS/Topical Mycology Symposium**. Liverpool John Moores Univ., Liverpool, UK. April 25-29, 2000.

Manoch, L., K. Jaroenthai, K. Busarakam, P. Athipunyakom, A. Somrith and O. Jeamjitt. 2001. Plant pathogenic, endophytic and soil fungi in Thailand. pp.

502-510. *In* **Proceedings of the 39th Kasetsart University Annual Conference.** Kasetsart University, Bangkok. Thailand.

Manoch, L., O. Jeamjitt, T. Dethoup, J. Kokaew and P. Poochinya. 2004. SEM study on ascospore ornamentation in Aspergillus and Penicillium teleomorphs from soil at termite mounds. **Journal of Microscopy Society of Thailand** 18 (1): 98-103.

Manoch, L., O. Jeamjitt, T. Dethoup, J. Kokaew, Y. Papun and P. Poochinya. 2005. SEM study on ascospore ornamentation in soil fungi. **Journal of Microscopy Society of Thailand** 19 (1): 211-212.

Matinez, C.C., W.E. Gray and D.C. Sands. 1992. First report of *Arthrinium arundinis* causing kernel blight of barley. **Plant Dis.** 76 (10): 1077.

Mejanelle, L., J.F. Lopez, N. Gunde-Cimerman and J.O. Grimalt. 2001. Ergosterol biosynthesis in novel melanized fungi from hypersaline environments. **J. Lipid Res.** 42: 352-358.

Migunova, V.D. and B.A. Byzov. 2004. Determinants of trophic modes of the nematophagous fungus *Arthrobotrys oligospora* interacting with bacterivorous nematode *Caenorhabditis elegans*. **Pedobiologia** 41: 101-108.

Morris, S.A, J.E. Curotto, D.J. Zink, S. Dreikhom, R. Jenkins, G.F. Bill, J.R. Thompson, F. Vincente, A. Basilio, J.M. Liesch and R.E. Schwartz. 1996.

Sonomolides A and B, new broad spectrum antifungal agents isolated from a coprophilous fungus. **Tetrahedron Lett.** 36: 9101-9104.

Moss, M.O. 2002a. Mycotoxin review-1. *Aspegillus* and *Penicillium*. **Mycologist** 16(3): 116-119.

Moss, M.O. 2002b. Mycotoxin review-2. *Fusarium*. **Mycologist** 16(4): 158-161.

Moss, M.O. 2003. Mycotoxin review-3. Houses and pasture. **Mycologist** 17(2): 79-83.

Nag Raj, T.R. 1993. **Coelomycetes Anamorphs with Appendage-bearing Conidia**. Mycologue Publication, Ontario.

Obrist,W. 1961. The genus *Ascodesmis*. **Can. J. Bot.** 39: 943-953.

Oh, H., D.C. Swenson, J.B. Gloer, D.T. Wicklow and P.F. Dowd. 1998. Chaetochalasin A: a new bioactive metabolite from *Chaetomium brasiliense*. **Tetrahedron Lett**. 39: 7633-7636.

Okane, I., A. Nakagiri andT. Ito. 1997. Preliminary study on endophytic fungi in evergreen plants Ishigaki and Iriomote Islands. **Res. Com. Ins. Ferm.** 18: 45-51.

Olsson, P.A., L. Larsson, B. Bago, H. Wallander and I.M. Aarle. 2003. Ergosterol and fatty acids for biomass estimation of mycorrhizal fungi. **New Phytologist** 159(1): 7-10.

Ondeyka, J.G., R.A. Giacobbe, G.F. Bills, C. Cuadrillero, D.M. Schmatz, A. Goetz, D.L. Zink and S.B. Singh. 1998. Coprophilin: an anticoccidial agent produced by a dung inhabiting fungus. **Bioorg. Med. Chem. Lett.** 8: 3439-3442.

Parker, A.D. 1979. Associations between coprophilous ascomycetes and fecal substrates in Illinois. **Mycologia** 71: 1206-1214.

Peberdy, J.F. 1987. **Biotechnology Handbook 1: *Penicillium* and *Acremonium***. Plenum Press. USA.

Pitt, J.I. and A.D. Hocking. 1997. **Fungi and Food Spoilage**. 2nd Ed. Cambridge Univ. Press.

Pointing, S.B. and K.D. Hyde. 2001. **Bio-Exploitation of Filamentous Fungi**. Fungal Diversity Press.

Powell, K.A., A. Renwick and J.F. Peberdy. 1994. **The *Aspergillus*: from Taxonomy and Genetics to Industrial Application**. FEMS Symposium 69. Plenum Press. USA.

Poyser, J.P., R.L. Edwards, J.R. Anderson, M.B. Hursthouse, N.P.C. Walker, G.M. Sheldrick and A.J.S. Whalley. 1986. Punctanin A,C, D and F (antibiotics M95464, M167906, M171950 and M189122), isomeric allylic alcohols from the fungus Poronia punctata: x-ray crystal structures of D and E acetonide. **J. Antibio.** 39: 167-169.

Ramos, A.M., M.E. Ranalli, F. Forchiassin and B.O. Saidman. 2000. Isozyme analysis of different of the genus *Saccobolus* (Ascomycetes, Pezizales). **Mycotaxon** 74: 447-462.

Raper, K.B. and D.I. Fennell. 1965. **The Genus *Aspergillus***. The William & Wilkins Company: Baltimore.

Richardson, M.J. 1972. Coprophilous ascomycetes on different dung types. **Trans. Brit. Mycol. Soc.** 58: 37-48.

Richardson, M. J. 2001a. Diversity and occurrence of coprophilous fungi. **Mycol. Res.** 105: 387-402.

_____. 2001b. Coprophilous Fungi from Brazil. **Braz. Arch. Biol. Technol**. 44(3).

Richardson, M.J. and R. Watling. 1997. Key to fungi on dung. W.J. Byford. (ed.). **Bull. Brit. Mycol. Soc.** 2: 18-46.

Rogers, J.D., Y.M. Ju and F.S. Martin. 1998. *Podosordaria*: a redefinition based on cultural studies of the type species, *P. mexicana,* and two new species. **Mycotaxon** 67: 61-72.

Saleem, M., B.C. Lamb and E. Nevo. 2001. Inherited differences in crossing over and gene conversion frequencies between wild strains of *Sordaria fimicola* from "Evolution Canyon". **Genetics** 159: 1573-1593.

Samson, R.A., E.S. Hoekstra, J.C. Frisvad and O. Filtenborg. 2002. **Introduction to Food-and Airborne Fungi**. 6th ed. Centraalbureau voor Schimmelcultures, Utrecht. The Netherlands. 389 p.

Schussler, A., D. Schwarzott and C. Walker. 2001. A. new fungal phylum, the Glomeromycota: phylogeny and evolution. **Mycol. Res.** 105: 1413-1421.

Seifert, K.A., B. Kendrick and G. Murase. 1983. **A Key to Hyphomycetes on Dung**. Department of Biology, University of Waterloo, Ontario.

Selvakumar, R., K.D. Srivastava, R. Aggarwal and D.V. Singh. 2002. Biocontrol of spot blotch of wheat using *Chaetomium globosum*. **Rev. Plant Patho.** 81: 1031-1032.

Sharples, G.P. and S.T. Moss. 2000. Techniques for the study of fungal ultrastructure: theory and practice. *In* **Electron Microscopy Workshop**. Scientific and Technological Research Equipment Centre (STREC). Chulalongkorn University, Bangkok, Thailand.

Singh, J. 1999. Ethnomycology and Folk Remedies: Fact and Fiction. pp. 11-17. *In* J. Singh and H.R. Aneja, eds. **From Ethnomycology to Fungal Biotechnology: Exploiting Fungi from Natural Resources for Novel Products**. Plenum Publishers, USA.

Sivanesan, A. 1987. **Graminicolous species of *Bipolaris, Curvularia, Drechslera, Exserohilum* and Their Teleomorphs**. CAB. International Mycological Institute. Wallingford.

Smith, D. and A.H.S. Onions. 1994. **The Preservation and Maintenance of Living Fungi**, 2nd ed. Commonwealth Mycological Institute, Kew, Surrey, England.

Soman, A.G., J.B. Gloer, B. Koster and D. Malloch. 1999. Sporovexins A-C and a new preussomerin analog: antibacterial and antifungal metabolites from the coprophilous fusgus *Sporormiella vexans*. **J. Nat. Prod.** 62: 659-661.

Somrithipol, S. and N.L. Hywel-Jones. 2002. A preliminary investigation on coprophilous fungi in Northeastern Thailand. pp. 409-414. *In* **Proceedings of the 40th Kasetsart University Annual Conference**. Kasetsart Univ. Thailand. February 4-7, 2002.

Somrithipol, S. 2004. Coprophilous fungi. pp. 119-128. *In*. E.B.G. Jones, M. Tanticharoen and K.D. Hyde, eds. **Thai Fungal Diversity.** BIOTEC, Thailand.

Soytong, K. 2004. Research and development of microbial products for Bio-agriculture: review article. pp. 10-13. *In* **Proceedings of the 1st KMITL International Conference on Integration of Science and Technology for Sustainable Development**. Bangkok, Thailand. Vol 2.

Subramanian, C.V. 1983. **Hyphomycetes, Taxonomy and Biology**. Academic Press. London.

Sutton, B.C. 1980. **The Coelomycetes, Fungi Imperfecti with Pycnidia, Acervuli and Stromata.** Commonwealth Mycological Institute, Kew, Surrey, UK.

Suzuki, S., T. Hosoe, K. Nozawa, T. Yaguchi, S. Udagawa and K. Kawai. 1999. Mitorubrin derivatives on ascomata of some talaromyces species of ascomycetous fungi. **J. Nat. Prod.** 62(9): 1328-1329.

Tanaka, M., T. Fukushima, Y. Tsujino and T. Fujimori. 1997. Nigrosporins A and B, new phytotoxic and antibacterial metabolites produced by a fungus *Nigrospora oryzae*. **Biosci. Biotech. Biochem.** 61(11): 1848-1852.

Tjamos, E.C. and D.R. Fravel. 1997. Distribution and establishment of the biocontrol fungus *Talaromyces flavus* in soil and on roots of solanaceous crops. **Crop Protection** 16(2): 135-139.

Van Brummelen, J. 1967. A world-monograph of the genus *Ascobolus* and *Saccobolus* (Ascomycetes, Pezizales). **Persoonia** 1: 1-260.

Van Brummelen, J. 1969. Studies on Discomycetes-III. **Persoonia** 5: 225-231.

Van Brummelen, J. 1977. A new genus of Pezizales from Thailand. **Kew Bulletin** 31: 617-620.

Vinale, F., R. Marra, F. Scala, E.L. Ghisalberti, M. Lorito and K. Sivasithamparam. 2006. Major secondary metabolites produced by two commercial Trichoderma strains active against different phytopathogens. **Lett. App. Microbio.** 43: 143-148.

Wallander, H., H.B. Massicotte and J.E. Nylund. 1997. Seasonal variation in protein, ergosterol and chitin in five morphotypes of *Pinus sylvestris* L. ectomycorrhizae in a mature swedish forest. **Soil Bio. Biochem.** 29: 45-53.

Wang, H.J., J.B. Gloer, J.A. Scott and D. Malloch. 1995a. Coniochaetones A and B: new antifungal benzopyranones from the coprophilous fungus Coniochaeta saccardoi. **Tetrahedron Lett.** 36: 5847-5850.

Wang, H.J., K.B. Gloer, J.B. Gloer, J.A. Scott and D. Malloch. 1997. Anserinones A and B: new antifungal and antibacterial benzoquinones from the coprophilous fungus *Podospora anserina*. **J. Nat. Prod.** 60: 629-631.

Wang, Y. and Y.Z. Wang. 2000. Notes on coprophilous discomycetes from southwestern China. **Fungal Science** 15: 125-134.

Wang, Y., J.B. Gloer, J.A. Scott and D. Malloch. 1993. Appenolidea A-C: three new antifungal furanones from the coprophilous fungus *Podospora appendiculata*. **J. Nat. Prod.** 56: 341-344.

Wang, Y., J.B. Gloer, J.A. Scott and D. Malloch. 1995b. Terezines A-D: novel bioactive metabolites from the coprophilous fungus *Sporormiella teretispora*. **J. Nat. Prod.** 58: 93-99.

Wang, Y.Z. 2000. The genus *Podospora* in Taiwan. **Mycotaxon** 76: 373-391.

Warcup, J.H. 1950. The soil-plate method for isolation of fungi from soil. **Nature** 166: 117-118.

Warcup, J.H. and K.F. Baker. 1963. Occurrence of dormant ascospore in soil. **Nature** 197: 1317-1318.

Watanabe, T. 1991. Evaluation of *Sordaria* spp. as biocontrol agents against soil-borne plant diseases caused by *Pythium aphanidermatum* and *Dematophora necatrix*. **Ann. Phytopath. Soc. Japan** 57: 680-685.

Weber, H.A and J.B. Gloer. 1991. Preussomerin A-F: novel antifungal metabolites from the coprophilous fungus *Preussia isomera* Cain. **J. Org. Chem.** 56: 4355-4360.

Weber, H.A., D.C. Swenson, J.B. Gloer and D. Malloch. 1992. Similins A and B: new antifungal metabolites from the coprophilous fungus *Sporormiella similis*. **Tetrahedron Lett.** 33: 1157-1160.

Weber, H.A., N.C. Baenziger and J.B. Gloer. 1988. Podosporin A: a novel antifungal metabolite from the coprophilous fungus *Podospora decipiens* (Wint.) Niessl. **J. Org. Chem.** 53: 4567-4569.

Weber, H.A., N.C. Baenziger and J.B. Gloer. 1990. Structure of Preussomerin A: an unusual new antifungal metabolites from the coprophilous fugus *Preussia isomera*. **J. Am. Chem. Soc.** 112: 6718-6719.

Weber, R.W.S. and H.T. Tribe. 2004. Moulds that should be better known: Thielaviopsis basicola and T. thielavioides, two ubiquitous moulds on carrots sold in shops. **Mycologist** 18(1): 6-10.

Webster, J. 1970. Coprophilous fungi. **Trans. Brit. Mycol. Soc**. 54: 161-180.

Webster, J. and R.W.S. Weber. 2000. Rhizomorphs and perithecial stromata of *Podosordaria tulasnei* (Xylariaceae). **Mycologist** 14: 41-44.

Weete, J.D. and Gandhi S.R. 1999. Sterols and fatty acids of the Mortierellaceae: taxonomic implications. **Mycologia** 91: 642-649.

Wei, D.L., S.C. Chang, S.C. Lin, M.L. Doong and S.C. Jong. 1994. Production of 3-nitropropionic acid by *Arthrinium* species. **Curr. Microbio.** 28 (1): 1-5.

Whyte, A.C., J.B. Gloer, J.A. Scott and D. Malloch. 1996. Cercopholins a-c: novel antifungal and cytotoxic metabolites from the coprophilous fugus *Cercophora areolata*. **J. Nat. Prod.** 59: 765-769.

Wicklow, D.T. 1985. *Aspergillus leporis* sclerotia form on rabbit dung. **Mycologia** 77: 531-534.

Wicklow, D.T. and V. Moore. 1974. Effect of incubation temperature on the coprophilous fungal succession. **Trans. Brit. Mycol. Soc.** 62: 411-415.

Yoganathan, K., C. Rossant, S. Ng, Y. Huang, M.S. Butler and A.D. Buss. 2003. 10-Methoxydihydrofuscin, fuscinarin, and fuscin, novel antagonists of the human CCR5 receptor from *Oidiodendron griseum*. **J. Nat. Prod.** 66(8): 1116-1117.

Zhao, Y.M., S.T. Wen, M.L. Lui, Y.B. Jiang, S.S. Zhang and S.P. Chen. 1997. Mycosis caused by *Arthrinium phaeospermum*, its toxicity and pathological analysis. **Mycosystema** 16 (2): 112-116.

APPENDIX

Culture media for isolating fungi

1. Gauchnaur's glucose Ammonium Nitrate Agar (GAN)

NH_4NO_3	1.0	g
K_2HPO_4	1.0	g
$MgSO_4.7H_2O$	0.5	g
Rose bengal	0.03	g
Yeast extract	1.0	g
Glucose	5.0	g
Agar	15.0	g
Streptomycin solution	30.0	ppm
Distilled water	1,000	ml

After medium has been autoclaved, 4 ml of 30 ppm streptomycin are added.

2. Water Agar (WA)

Difco bacto agar	15.0	g
Distilled water	1,000	ml

Culture media for cultivating fungi

1. Potato dextrose agar (PDA)

Potato	200.0	g
Dextrose	20.0	g
Agar	15.0	g
Distilled water	1,000	ml

2. Potato dextrose broth (PDB)

Potato	200.0	g
Dextrose	20.0	g
Distilled water	1,000	ml

3. Czapek-Dox agar (CZA)

$NaNO_3$	3.0	g
K_2HPO_4	1.0	g
$MgSO_4.\ 7H_2O$	0.5	g
KCl	0.5	g
$FeSO_4.\ 7H_2O$	0.01	g
Sucrose	30.0	g
Agar	15	g
Distilled water	1000	ml

4. Cornmeal agar (CMA)

Difco cornmeal agar	17.0	g
Distilled water	1,000	ml

5. Malt extract agar (MEA)

Malt extract agar	25.0	g
Agar	20.0	g
Distilled water	1,000	ml

Mounting medium

Lactophenol Mounting Medium

Phenol (crystals)	20.0	g
Lactic acid	20.0	g
Glycerol	40.0	g
Distilled water	20.0	g