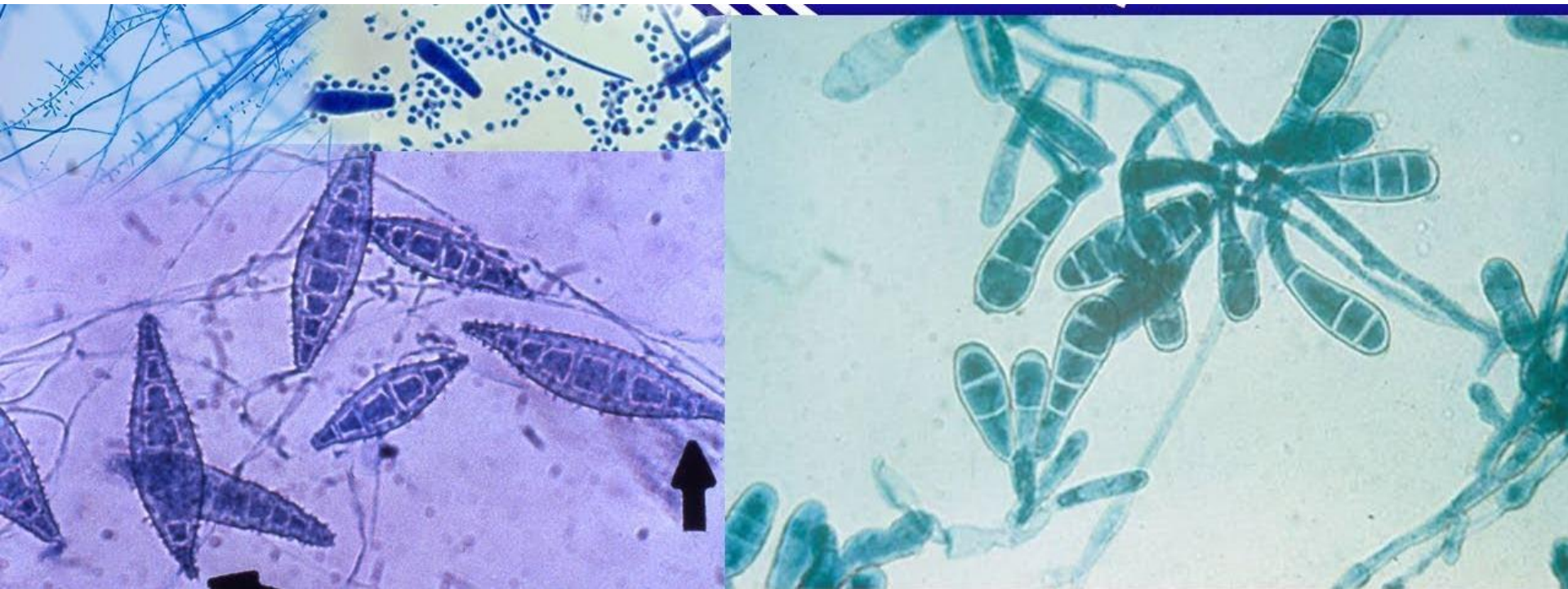


DERMATOPHYTES

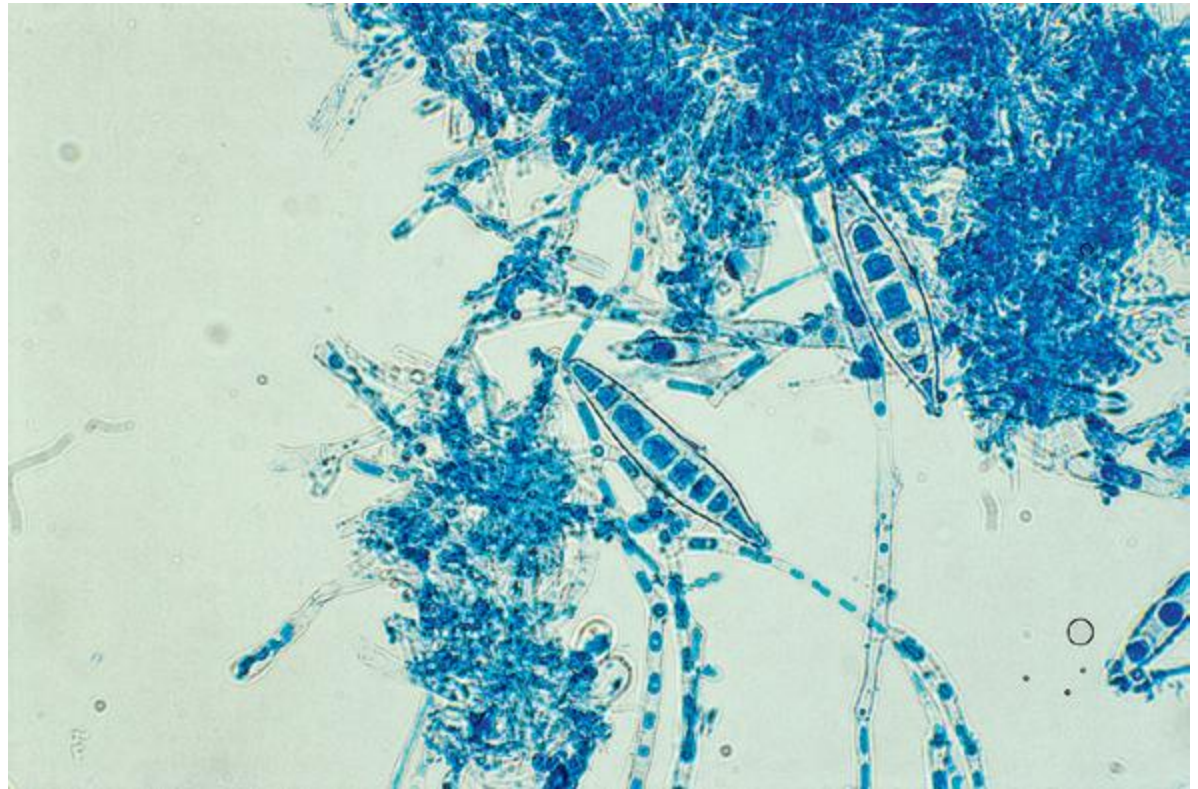


Introduction

- ▶ Fungi that require and use keratin for growth
- ▶ Confined to the superficial integument of the skin, nails, claws & hair of animals and man
- ▶ Classical lesions- circular (ringworm)
- ▶ Traditionally the dermatophytes are placed in the Deuteromycota or Fungi Imperfecti in 3 genera:
Microsporum,
Trichophyton
Epidermophyton

Microsporum

The *Microsporum* species tend to produce spindle shaped macroconidia



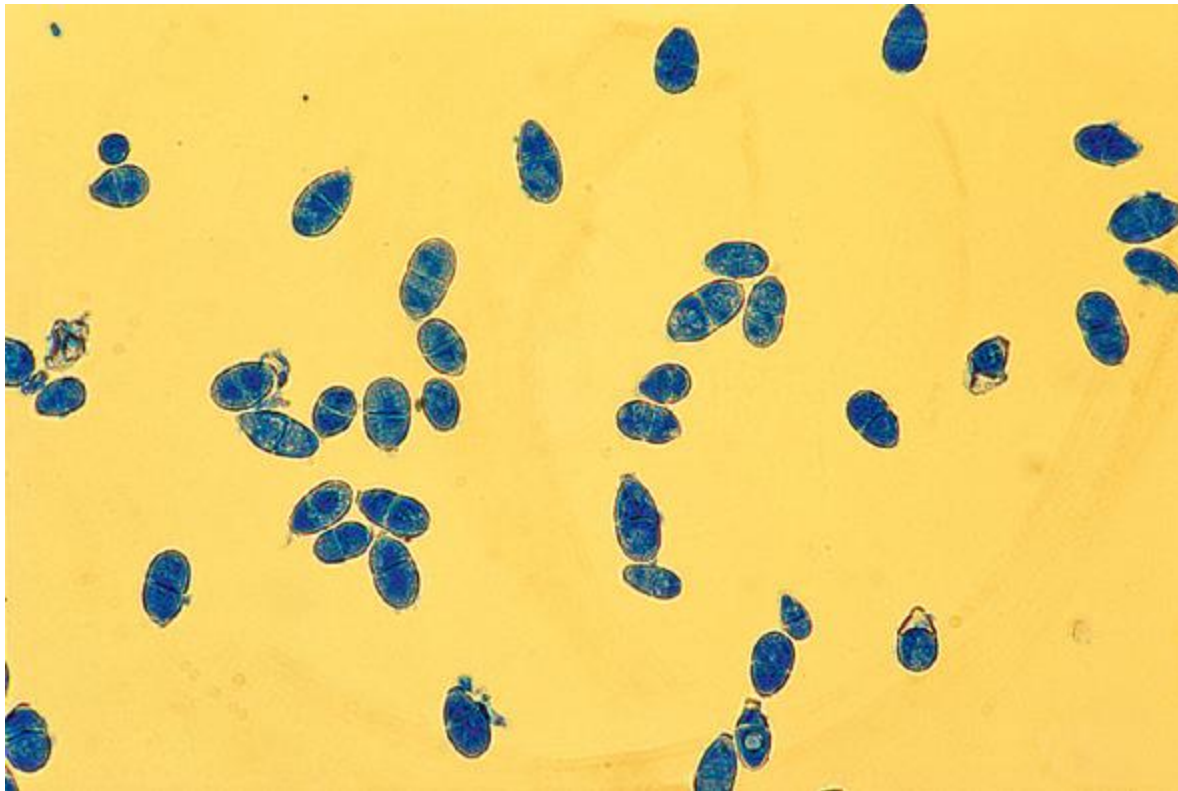
Microsporum canis: spindle-shaped macroconidia. (LPCB, ×400)



Microsporium gypseum: boat shaped macroconidia. (LPCB)



Trichophyton mentagrophytes: cigar shaped numerous microconidia and a macroconidium.

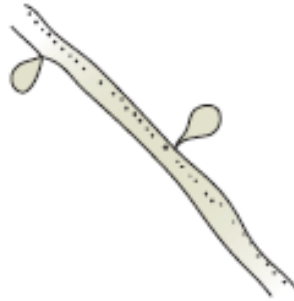


Microsporium nanum: round & two celled macroconidia. (LPCB)

Microsporum species

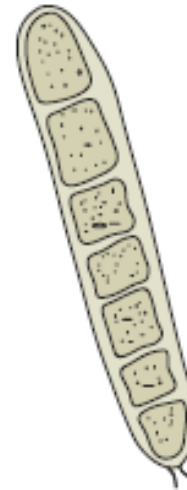


Macroconidium

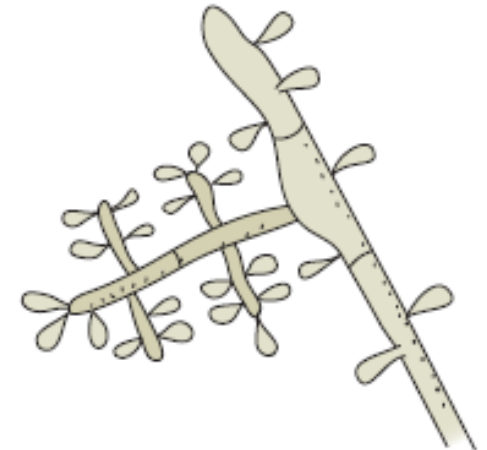


Microconidia

Trichophyton species



Macroconidium



Microconidia

Macroconidium

Large thick-walled and divided into many cells by transverse septa. Tend to be spindle- or boat-shaped.

Few or absent in some species. If present they are elongated and cigar- or pencil-shaped. The walls are thin and smooth. Divided by septa into 3–8 cells.

Microconidia

Relatively few or absent. If present they are tear-shaped and borne singly on the hyphae.

Usually numerous and borne singly along the hyphae or in grape-like clusters.

Figure 38.5 Microscopic differentiation of the dermatophyte genera affecting animals.

USUAL HABITAT

- Dermatophytes can be grouped on the basis of their habitats and the host preferences as:
- Geophilic
- Zoophilic
- Anthropophilic

Natural Habitat

- ▶ The geophilic (soil-loving) dermatophytes inhabit the soil and can exist there as free-living saprophytes. Example- *Microsporum gypseum* and *M. nanum*
- ▶ The zoophilic dermatophytes are obligate pathogens, primarily parasitizing animals but also capable of infecting humans.
- ▶ Humans are the main host for the anthropophilic dermatophytes and these very rarely cause ringworm in animals

- ▶ Some dermatophytes have become adapted for survival in the skin of specific host animals, for example:
- ▶ *Microsporum canis*: cats
- ▶ *Microsporum persicolor*: voles
- ▶ *Trichophyton mentagrophytes* var. *mentagrophytes*: rodents
- ▶ *Trichophyton verrucosum*: cattle.



Trichophyton erinacei:
muzzle alopecia in a
terrier known to worry hedgehogs

Table 38.1 Dermatophytes of veterinary significance

Species	Hosts	Geographical Distribution	Colonial Appearance	Microscopic Appearance
<i>Microsporum canis</i> (var. <i>canis</i>)	Cats, dogs, important cause of ringworm in humans	Worldwide	Growth rapid. Surface white and silky at centre with bright yellow periphery. Reverse side bright yellow or orange	Usually abundant macroconidia. They are spindle-shaped and mature spores end in a distinct knob. Cells 6–15, size 8–20 × 40–150 µm. Few microconidia
<i>M. canis</i> var. <i>distortum</i>	Dogs	North America, New Zealand, Australia	Growth fairly rapid. Surface white to tan and reverse white or yellowish tan. Colony is velvety to fluffy with a tendency to form radial grooves	Usually abundant macroconidia that are distorted in shape, thick-walled and multicellular. Size 12–27 × 30–60 µm. Numerous microconidia
<i>M. canis</i> (syn. <i>M. equinum</i>)	Horses	Worldwide	Slow growth. Surface white and velvety to finely powdery. Reverse salmon or buff	Macroconidia rare, resemble shortened <i>M. canis</i> macroconidia, size 5–15 × 18–60 µm
<i>M. gypseum</i>	Horses, dogs, rodents	Worldwide (in soil)	Fairly rapid growth. Colony is flat, powdery with a fringed border. Obverse is buff to cinnamon-brown and reverse pale yellow to tan or occasionally red. Odour similar to a	Abundant macroconidia. Boat-shaped with rounded ends and thick, rough walls.

<i>M. nanum</i>	Pigs	North and South America, Europe, Australasia (in soil)	Colony is flat, white and cottony at first, later granular and buff-coloured	Abundant macroconidia, pear-shaped with spiny walls. Cells 1–3, size 4–8 × 12–18 µm
<i>M. gallinae</i>	Chickens, turkeys	Worldwide	Rapid growth. Surface white to pinkish, velvety and folded. Reverse strawberry-pink, diffusible pigment	Abundant macroconidia, fusiform with blunt spatulate tips. Walls smooth and thick. Cells 2–10, size 6–8 × 15–50 µm
<i>Trichophyton equinum</i>	Horses	Worldwide	Fairly rapid growth. Colony initially flat, white and fluffy but later velvety with central folding. Cream to tan in colour, reverse is yellow to reddish-brown	Macroconidia are rare. Slightly club-shaped, smooth, thin-walled with 3–5 cells. Abundant microconidia. Chlamydospores are abundant in old cultures
<i>Trichophyton equinum</i> var. <i>autotrophicum</i>	Horses	New Zealand, Australia	Colony at first white with a raised centre, later white to buff with folded centre. Reverse is yellow becoming dark rose-red	Macroconidia not reported

Table 38.1 Dermatophytes of veterinary significance—cont'd

Species	Hosts	Geographical Distribution	Colonial Appearance	Microscopic Appearance
<i>T. mentagrophytes</i> var. <i>mentagrophytes</i>	Rodents, dogs, horses and many other species	Worldwide	Rapid growth. Two colony forms: 1. Granular, obverse cream, reverse buff-tan to dark-brown; 2. Downy, white and woolly with older colonies becoming cream-tan, reverse varies from white through yellow to reddish-brown	Macroconidia cigar-shaped, thin-walled. Cells 3–7, size 4–8 × 20–50 µm. Abundant microconidia in grape-like clusters
<i>T. mentagrophytes</i> var. <i>erinacei</i>	European hedgehogs, dogs	Europe, New Zealand	Rapid growth. Colony finely granular and flat with raised centre. Fringed subsurface border. Obverse white to cream, reverse brilliant yellow	Macroconidia uncommon. Irregular shape and size, smooth, thin-walled. Cells 2–6
<i>T. mentagrophytes</i> var. <i>quinckeanumi</i>	Mice	Australia, North America, Europe	Colony initially white and fluffy, becoming downy and deeply folded. Reverse is deep yellow becoming orange-brown	Macroconidia rare. Smooth, thin-walled, cigar- to club-shaped. Cells 4–6

<i>T. simii</i>	Monkeys, poultry, dogs	Brazil, Guinea, India (in soil)	Rapid growth. Finely granular colony with diffuse margin, white to pale or rose-buff. Reverse white and later reddish-brown	Abundant macroconidia, cylindrical to fusiform in shape. Cells 3–10, size 6–11 × 35–85 µm
<i>T. verrucosum</i>	Cattle	Worldwide	Very slow-growing. Small, white, velvety, heaped and folded colony. Obverse white or whitish-grey and occasionally yellow-ochre, reverse is white	Macroconidia very rare but characteristic chains of chlamydospores

Pathogenesis

- ▶ Infective arthrospores germinate within 6 hours of adhering to keratinized structures.
- ▶ Minor trauma of the skin and dampness may facilitate infection.
- ▶ The ability of the dermatophytes to hydrolyse keratin causes damage to the epidermis, hair shafts, hair follicles and feathers.
- ▶ The host mounts an inflammatory response to the fungal metabolic products that is harmful to the fungus, so the dermatophyte moves away peripherally towards normal skin.
- ▶ The result is the commonly seen circular lesions (ringworm) of alopecia with healing at the centre and inflammation at the edge



Trichophyton equinum:
typical ringworm lesions
in a horse (bridle area)

- ▶ The manifestations of dermatophyte infections can vary and may be summarized as:

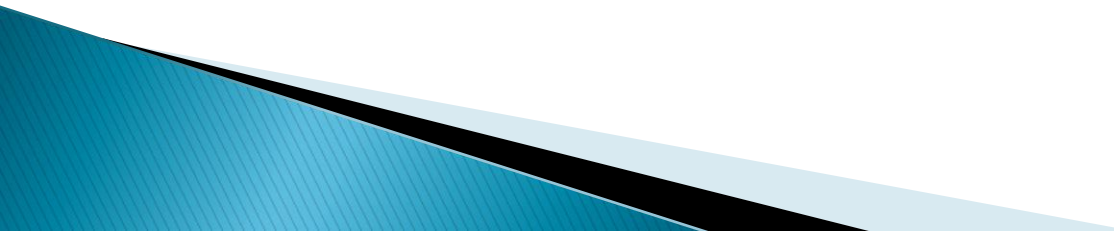
Subclinical or inapparent infections

Classical round ringworm lesions

Serious generalized lesions that may be complicated by mange mites or by secondary bacterial infection, in particular by *Staphylococcus aureus* or *S. pseudintermedius*

Nodular or tumourous lesions called kerions, seen most commonly in dogs.

Laboratory Diagnosis

- ▶ **Preliminary examination: Wood's lamp**
 - ▶ *Microsporum* spp. produce certain metabolites when growing on hairs and skin that fluoresce a vivid apple-green under the ultraviolet light of a Wood's lamp.
 - ▶ The animal itself can be examined with the lamp in a dark room and the site of the lesions will fluoresce.
 - ▶ Alternatively, the lamp can be used to examine plucked hairs or skin scrapings taken from lesions
- 

Specimens

- ▶ Hairs
- ▶ Scab material

Wood's lamp/light

This light is a long-wave ultraviolet rays passing through a glass containing nickel oxide. Certain fungi fluoresce when examined by Wood's light e.g. *Microsporum canis* gives bright green fluorescence and *Trichophyton schoenleinii* gives dull green fluorescence.



Infected hair fluoresces bright green, beads on hairs contrasting strongly with dark field.

Direct microscopy

- ▶ KOH wet preparation
- ▶ Round, refractile arthrospores surrounding the hair or on pieces of scab material



Trichophyton verrucosum: infected bovine hair
with arthrospores. (10% KOH, $\times 400$)

Isolation

- ▶ Emmons' Sabouraud dextrose agar (pH 6.9)
- ▶ Trichophyton media, developed for the *Trichophyton species*.
- ▶ *The control medium* is known as trichophyton agar 1 (T1) and is a casein basal agar

- ▶ Growth factors are added as required:
- ▶ *Trichophyton verrucosum*: requires thiamine or thiamine and inositol (trichophyton agar 3)
- ▶ *Trichophyton equinum*: requires nicotinic acid (trichophyton agar 5)
- ▶ *Microsporum gallinae*: thiamine stimulates growth (trichophyton agar 3)

- ▶ A light inoculum of hairs and skin scrapings can be scattered over the surface of the agar and gently pressed down on the medium with a swab or sterile forceps
- ▶ The dermatophyte cultures are incubated aerobically at 25°C

- ▶ Dermatophyte test medium (DTM), which can be obtained commercially, is a selective and differential medium for dermatophytes containing the pH indicator phenol red
- ▶ The dermatophytes produce alkaline metabolic products changing the medium from yellow to red

Laboratory diagnosis of dermatophytes

- In addition, the color change in DTM can obscure the characteristic pigmentation required for differentiation of dermatophyte species.

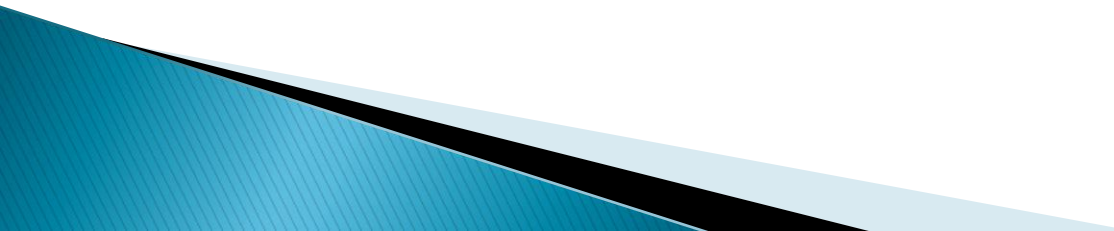


A. Dermatophyte Test Medium (DTM)
Sterile medium yellow.
B. DTM Positive



DTM plate on the right showing color change after two day's growth;
[Microsporum canis](#)

Identification

- ▶ Usually a dermatophyte can be identified by the animal host from which it was isolated
 - ▶ Colonial appearance
 - ▶ Microscopic characteristics of the colonies
- 

Colonial appearance

- ▶ Rate of growth
- ▶ Texture and pigmentation of the colony

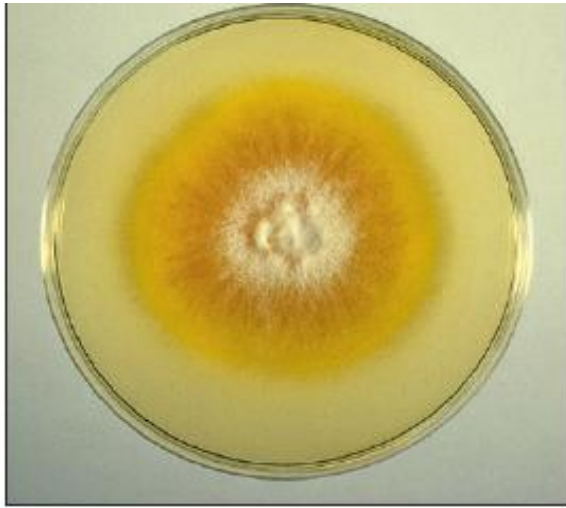


Figure 38.9 *Microsporium canis* on Sabouraud agar, 10 days.

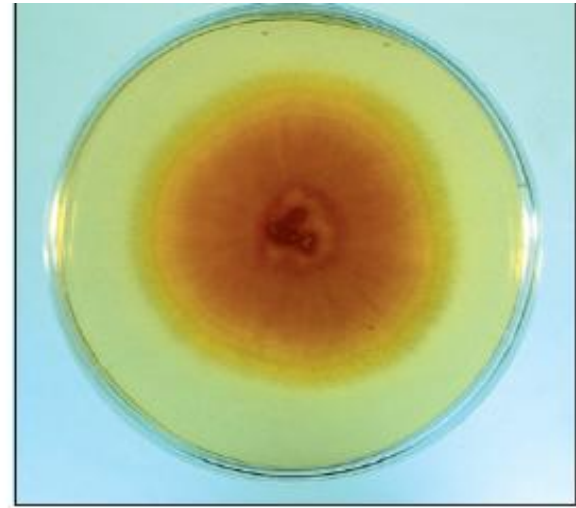


Figure 38.10 *Microsporium canis* on Sabouraud agar, 10 days. Reverse.



Figure 38.11 *Microsporium gypseum* on Sabouraud agar, 12 days.

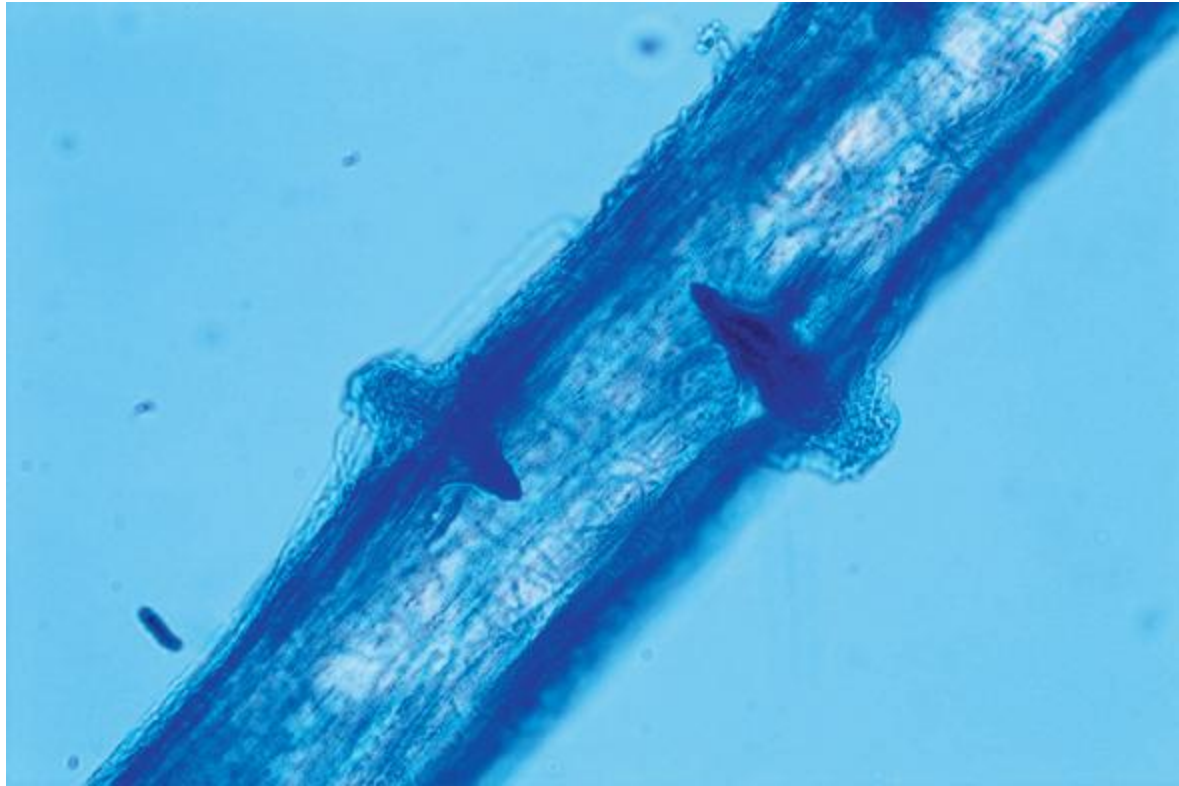


Figure 38.12 *Microsporium gypseum* on Sabouraud agar, 12 days. Reverse.

Hair perforation test

- ▶ This test is used mainly in medical mycology as an aid to distinguish *T. mentagrophytes* from *T. rubrum* and atypical *M. canis* from *T. equinum*
- ▶ Collect hairs and Layer the sterile hairs on a 3–5-day-old subculture of the dermatophyte under test and incubate at 25°C
- ▶ Examine the hairs daily from seventh day of incubation onwards by mounting a few hairs in lactophenol cotton blue and examining them

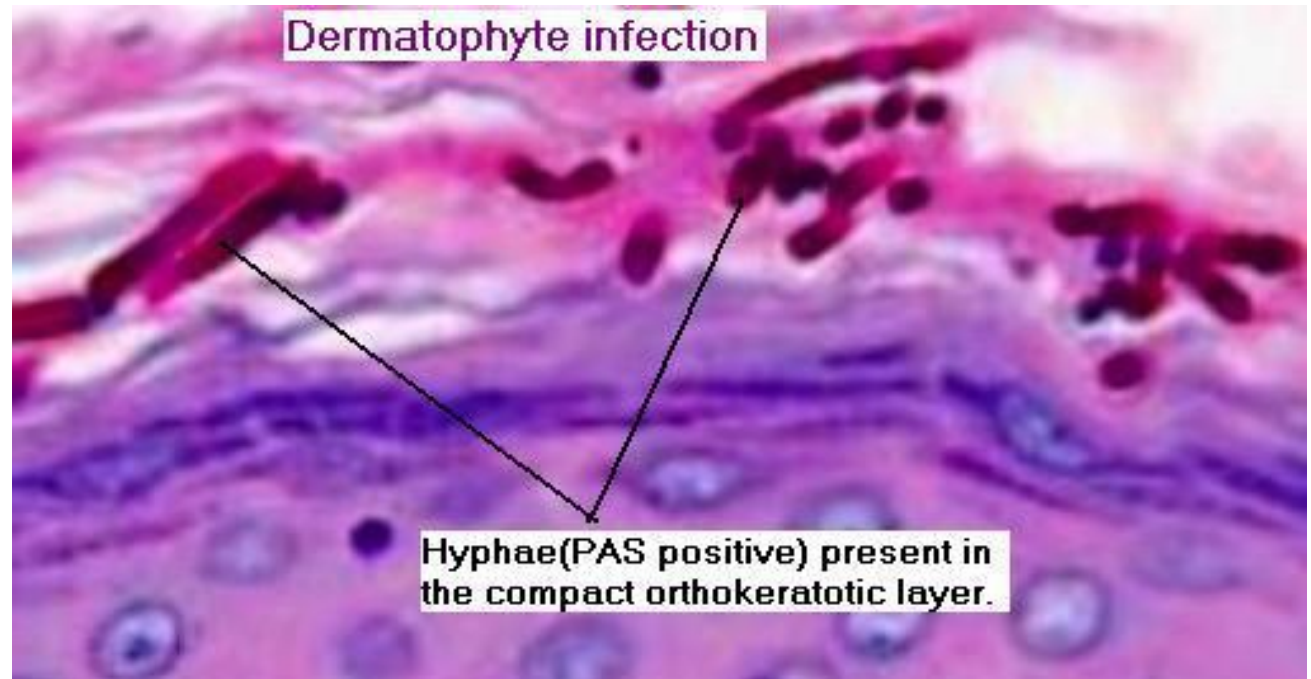
- ▶ *Trichophyton mentagrophytes* and *M. canis* have the ability to invade the hair shaft and produce conical perforations of the hair, seen in LPCB preparations as wedge-shaped areas
- ▶ *Trichophyton rubrum* do not penetrate the hair but grow on the surface.



Trichophyton mentagrophytes: illustrating in vitro hair penetration by this dermatophyte seen as wedge-shaped, dark-blue areas. (LPCB, $\times 400$)

Histological sections

- ▶ PAS and methenamine silver



Molecular techniques

- ▶ DNA-based techniques have been developed for the detection of fungal DNA in dermatological specimens and for use in identifying isolated fungi