Dermatophilosis is a contagious skin disease caused by *Dermatophilus congolensis*. The disease is non-pruritic, and is characterized by exudative, proliferative or hyperkeratotic dermatitis, accompanied by the production of crusts and folliculitis [22]. The causative organism is an aerobic, actinomyctete, a gram-positive bacterium that produces motile zoospores; it invades the skin and causes an acute, subacute or chronic skin disease.

Several factors are involved in the pathogenesis of dermatophilosis; among them are mechanical injury to the skin, rainfall, tick infestation, concurrent diseases and or stresses that compromise the host’s immune system [2, 19].

It is generally accepted that in the rainy season, owing to devitalizing effects on the skin barriers, the high relative humidity has a significant influence on the maturation and motility of the infective zoospores, and it has been claimed to be a major predisposing factor in the spread and epizootiology of dermatophilosis [22].

Latently infected animals may serve as the major reservoir of infection [16]. The organism persists in dry scabs and crusts, and can survive in the environment for long periods (up to 42 months) [11, 7]. It may be transmitted by direct contact with a carrier host, by contaminated fomites or by biting and non-biting flies [13].

Dermatophilosis in small ruminants is of especial importance in tropical and subtropical regions. The disease was first reported in goats by Beaton in 1928 (cited by MEMERY in 1960) [8], and has since been described by others [10, 15, 4, 3, 9].

Several different clinical forms of dermatophilosis in goats have been described [8]. The present study describes the clinical and epizootiological aspects of an outbreak of dermatophilosis in goats in the Judean foothills in Israel.
Materials and methods

EPIZOOTIOLOGICAL AND CLINICAL SURVEY

Two hundred and thirty-eight goats were examined clinically. The animals included in this study were from two herds that grazed in the Judean foothills all the year round. The breed involved was the local goat, which is reared for meat and milk production. The goats were mixed with sheep which herded together.

The Judean foothills are located 250-350 m above sea level. The mean annual precipitation is 420 mm, with temperatures of 21-28°C and a mean relative humidity of 55-60 %. The Mediterranean climate in the area is characterized by a hot dry summer from April to October and a cool rainy winter from November until March. The vegetation includes the major components of Mediterranean maquis on rendzina soils: Sarcopoterium spinosum, Hyparrhenia hirta, Calycotome villosa, Cistus salvifolius, Salvia fruticosa, Majorana syriaca and several annual Gramineae.

Heavy rains were recorded in the winter of 2001-2002 (556 mm), particularly during January 2002, when 265 mm fell (Fig. 1), compared with the multiyear average of 83 mm for that month (Meteorological Station, Bet Dagan). The goats were examined clinically once weekly during the morbidity period, which lasted from January 2002 to April 2002.

BACTERIOLOGY

Samples of crusts and scabs from affected goats were collected into sterile tubes. Direct impression smears were taken from the underside of the crusts and stained with Gram and Giemsa for direct microscopic examination.

Bacteriological cultures were made from six samples from affected animals, according to ABU-SAMRA [1]. Identification of *D. congolensis* was confirmed by microscopic examination of the Giemsa-stained smears; the bacterium was isolated, and susceptibility tests were performed by the standard methods of the US National Committee for Clinical Laboratory Standards [17].

HISTOPATHOLOGY

Biopsies (n = 5) from the skin of severely affected goats were fixed in 10 % buffered formalin, embedded in paraffin, and cut into 4-μm sections. The sections were stained with HE and studied under a light microscope.

The severely affected animals were treated with penicillin (50,000 units/kg body weight during three consecutive days, and by topical application once daily of povidone iodine.

Results

The onset of the incidence of dermatophilosis was correlated with heavy rainfall (Fig. 1). The morbidity rate reached 16 % (38 animals). Most of the affected animals (81.5 %) were under 2 years of age.

The lesions were most prominent over the ears, muzzle, nostrils, chin and scrotum (Figs. 2-5). Cauliflower-like, proliferative skin overgrowths were localized mainly on the ears (Fig. 2b), muzzle, nostrils and chin (Fig. 3). Exudative dermatitis with a significant inflammatory response was observed on the ears (Fig. 2a) (on both sides of the pinna and bilateral) and scrotum (Fig. 4), and there were proliferative lesions on the legs (Fig. 5). Scratching was not observed in the affected animals.

Diagnosis was based on clinical appearance, epizootiology of the disease, and bacteriological (Fig. 6) and histological (Fig. 7) examinations.

BACTERIOLOGICAL EXAMINATIONS

Microscopic examinations of skin lesions revealed typical hyphal forms, showing various degree of transverse and longitudinal septations (Fig. 6a), composed of rows of gram-positive coccoid elements, and hypha dividing into zoospores prior to release (Fig. 6b).

The positive bacteriological culture revealed typical haemolytic, dry, rough, adherent colonies, sunken into the substrate. Semiaerobic conditions enhanced the growth of the bacterium. The isolated *D. congolensis* showed sensitivity to penicillin.

HISTOPATHOLOGICAL EXAMINATION

Two histopathological forms of the disease were distinguished: 1) The acute form was characterized by suppurative dermatitis, congested oedematous epidermis infiltrated with neutrophils, and micro-abscess formation. The epidermis was covered with encrusted exudates (exudative form). The epidermal layer and the hair follicles were invaded by morphologically distinct filamentous bacteria consistent with *D. congolensis*. 2) The chronic forms were characterized by extensive mononuclear cell infiltration with proliferative changes including parakeratosis, hyperkeratosis, acanthosis and dermal sclerosis.

None of the humans who were in contact with the goats showed clinical signs of dermatophilosis.

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**Fig. 1.** — The incidence of dermatophilosis in association with rainfall.
DERMATOPHILOSIS IN GOATS IN THE JUDEAN FOOTHILLS

FIG. 2. — Skin lesions of dermatophilosis on the ears; a - exudative dermatitis, b - hyperkeratotic dermatitis.

Fig. 3. — Cauliflower overgrowth on the muzzle, nostrils and chin.

FIG. 4. — Exudative dermatitis on the scrotum.

FIG. 5. — Proliferative lesions on the legs.

FIG. 6a. — Young hypha: note longitudinal division only.
FIG. 6b. — Hypha dividing into zoospores prior to release: note binary division pattern and grouping.

FIG. 7. — Perifolliculitis with intralesional presence of Dermatophilus congolense organisms (upper right) (H&E x 20).
The tick species which were collected from the goats were: *Rhipicephalus bursa* (larvae and nymphs), *R. tariicus* (adults), *Haemaphysalis cretica* and *H. otophila* (adults), and *Hyalomma anatolicum excavatum* (adults).

**Discussion**

The pathogenesis and the close association between wet weather or showering, and dermatophilosis has been well established [2, 19, 20, 21]. For all animals, the intensity of rain is probably more important than the total amount of rainfall. Severe wetting or saturation of the hair and skin for several days or weeks is associated with a greater local prevalence of dermatophilosis than is found in areas subjected to high, but intermittent and even distributed rainfall [5].

In the region of the Judean foothills there has been a marked variation in the incidence of dermatophilosis observed in goats through the years. There is strong evidence that the outbreak of dermatophilosis in the present study was related to the intense and prolonged rainfall in the winter of 2001-2002, when protective skin barriers were damaged, and, in addition, environmental conditions were created which favoured the development and spread of dermatophilosis in the goat herds. Similar conclusions have been presented by others [22, 2, 9, 20].

However, the rain *per se* was clearly not the only factor involved in these infections. The roles of biting flies [13] and ticks [6], and the importance of the type of vegetation in the epidemiology of dermatophilosis have been discussed previously [6].

The role of the tick species collected from the affected animals, mainly from the ears and legs in the present survey, in the epizootiology of dermatophilosis is still unknown. It might be concluded that the organism lives saprophytically on the skin of chronically infected carrier animals during the dry season, and may then serve as a primary source of infection at the onset of the rainy season [19, 20], which might have happened in the present case also. It also seems that the thorny shrubs which are widespread in the pasture may have injured the long ears and the scrotum.

The skin lesions described in the affected goats could be symptoms of a variety of pathological conditions. Thus, the aetiology of such a disorder cannot be diagnosed with certainty from the clinical appearance alone; laboratory confirmation is necessary.

When the disease affects the scrotum of infected animal, it may consequently cause some somatic changes such as defects in spermatozoa or epididymis and concurrent infertility [12, 14]. Unfortunately, the sperm quality was not examined in the affected billy-goat.

The findings clearly revealed the presence of *D. congolensis* in the skin lesions and agreed with those of MSAMI *et al* [9]. The organism invades the skin and causes a disease characterized by an exudative epidermitis with scab formation [22], the lesions being confined to the epidermis and the hair follicles [9] as was also found in the present study.

Dermatophilosis infection has been reported as a zoonotic disease [5, 18], but in the outbreak described here, none of the people who had been in contact with the infected goats suffered skin lesions. Treatment of the severe cases with penicillin combined with topical application of povidone iodine was successful.

The complexity of such an infection, which is influenced by various environmental factors and probably also by the resistance of the affected host do not yet allow predictions concerning the roles of the agents involved, nor any evaluation of their relative importance.

**References**