ACTA THERIOLOGICA
Vol. 21, 38: 543—548, 1976

Fragmenta Theriologica

The Influence of Mole Tunnels on Soil Moisture on Pastures [1]

Wpływ nor kreta na wilgotność gleby na pastwiskach

Stanisław SKOCZEŃ, Helena NAGAWIECKA, Krzysztof BOROŃ
& Aleksy GAŁKA

Skoczeń S., Nagawiecka H., Boroń K. & Gałka A., 1976: The influence of mole tunnels on soil moisture on pastures. Acta theriol., 21, 38: 543—548. [With 1 Table & 4 Figs.]

Soil moisture was studied (after rainfall and in the postdry period) in adjacent tunnels of the mole (*Talpa europaea* Linnaeus, 1758) and in control samples on permanent grassland of the pasture type. The results obtained suggest the drying role of mole tunnels. In this places soil drying may reach the point of inducing permanent plant wilting.

[Inst. Appl. Zool., Acad. Agric., 30-059 Kraków, Mickiewicza 24—26, and Inst. Water Contr. in Agric. Forest., 30-059 Kraków, Mickiewicza 24—26]

INTRODUCTION

The mole is one of the most common mammals in many areas of Poland. Its presence on a locale is usually marked by a great number of hills and tunnels running in topsoil and subsoil strata. Thus for example, there were 7,380 hills raised during a year amount a total weight of 64.5 thousand kilogrammes and total volume of 40 m^3 on a hectare of a meadow studied by Grulich (1959). The molehills covered 7% of the meadow area and the total length of the underground tunnels was 25 km. Our calculations carried out on a meadow near Kraków with a surface highly disturbed by moles indicated that the number of hills/ha was from 4,107 to 21,063 and their total weight was from 25 to 63 thousand kilogrammes (at average soil moisture). The per cent of the occupied surface by the molehills fluctuated between 4.3 and 11.2.

The data quoted above point out that such a substantial number of mole tunnels in the soil must specifically soil moisture as the system of mole tunnels is a kind of a complex ventilation system (Olszewski & Skoczeń, 1965). According to Popova (1962) burrows of small mammals play various roles in humidification and drying of the

[1] The work was partly financed by the Committee for Ecology of the Polish Academy of Sciences.

soils in deciduous forests depending on the amount of rainfall, the spatial character of the tunnels, their depth, and most importantly, soil permeability. A b a t u r o v (1968) identified the role of mole tunnels with the so-called »Mole draining«. V o r o n o v (1968) also stressed the drying role of the tunnels on forest soils. According to G r i n e l l (1923) the presence of gopher (*Thomomys*) burrows, makes water stay longer on a porous territory. Snow thaws slowly and during spring flooding the hills stop water runnoff, arrowing it to into the soil. Therefore the areas on which burrows are found have richer vegetation than the areas with compact soil. J o ń c a (1964) states that the systems of underground cannals such as those of moles are, in mountane areas, the lines of intensive runoff of spring and rainfall water, resulting in severe erosion in this places.

The aim of this work was to study the influence of mole tunnels on the distribution of soil moisture in grasslands, to define the range and directions of the changes in soil moisture caused by the tunnels and the influence of the changes on habitat conditions on the examined areas.

METHODS

The research was done mainly on Błonia (the Cracov Common) on an area of 50 ha typical for natural grassland in regard to both soil and the morphology of the countryside. The surface of the pasture is covered with turf and is destroyed by moles to a great extent.

The soil of the areas examined were classified according to the system of the Polish Association of Soil Science (PTG) as alluvial grounds and black gleyed soils (loamy, dust-like). Ground water level was below 150 cm. A number of physical and water characteristics were estimated with methods commonly used in soil science.

Moisture of soil samples was gravimetrically estimated. Samples were taken at the points of line crossing in the network of squares in verticall (50 × 25 cm) and in horizontal (2 × 2 m) planes (Fig. 4). In the latter case the samples were taken in each 10 cm thick strata with the simultaneous inventory of the course of the tunnels.

Measurements of the distribution of the soil moisture were carried out three times during the vegetation periods of 1973 and 1974 and special care was taken to collect the samples: a) directly after rainfalls, b) several days after rainfall, c) during the postdry period.

RESULTS AND DISCUSSION

It was discovered that soil moisture was highest 2 days after heavy rainfalls at the depth of 0—15 cm and it receded with depth increased (22—42% of weight). At 20—40 cm soil was driest (20—22% of weight) and below 40 cm, moisture content increased again (Fig. 1 A). Such distribution of soil moisture may be the result of humidification about 20 cm by rainwater.

The drying role of mole tunnels was clearly observed and it was most distinct in the layers close to the tunnels where soil moisture was much lower (15% of weight), compared with moisture distribution in profile B at the some depth (20—22% of weight). In the layers directly below the tunnel moisture increased (Fig. 1). The exchange of water vapor between the air of tunnels and the atmosphere may explain the drying role of the tunnels. This is caused by the vapor pressure difference between the two places. The drying role of the tunnels decreases as their depth increases and is still marked at about 15—20 cm from the axis of the burrows. The drying immediately around the mole burrow

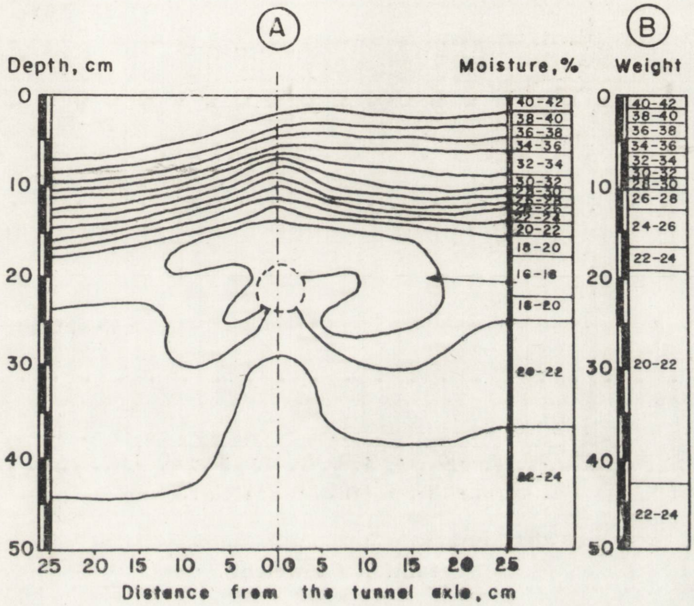

Fig. 1. Soil humidity distribution two days after rainfall.
A — in tunnel cross-sections, B — in control profile (without tunnels).

Table 1

Some average physical and water qualities of soil.

Depth (in cm)	0—10	11—29	30—68	69—130
Specific gravity (g/cm^3)	2.57	2.65	2.65	2.59
Volumetric gravity (g/cm^3)	1.11	1.35	1.35	1.24
General porosity P_o (%)	56.7	49.2	49.2	52.1
Field water content volume (in % weight)	33.9	31.30	31.30	31.99
Water Max. higr. WH_x (% weight)	9.45	8.36	8.43	10.19
Point of wilting $1.5 \times WH_x$ (in % weight	4.17	13.44	12.64	15.28
Filtr. coef. K_{10} (cm/sek)	8.68×10^{-4}	3.14×10^{-4}	1.39×10^{-4}	0.602×10^{-4}

reached critical values from the point of view of plant physiology, *i. e.*, it neared the point of causing permanent wilting (Table 1).

The observed local increase of moisture under the mole tunnels might be caused by the percolation of rainfall water running off the bottom of the tunnel. A similar role of the tunnel is presented on Fig. 2, which presents moisture distribution in the layers of soil profile several days after rainfall in March 1974. A higher percentage of moisture in individual layers observed in spring (Fig. 2) results from greater water storage by soil at that time. Also in the postdry period (Fig. 3) a distinct drying role of mole tunnels is observed. Surface layers of the profile

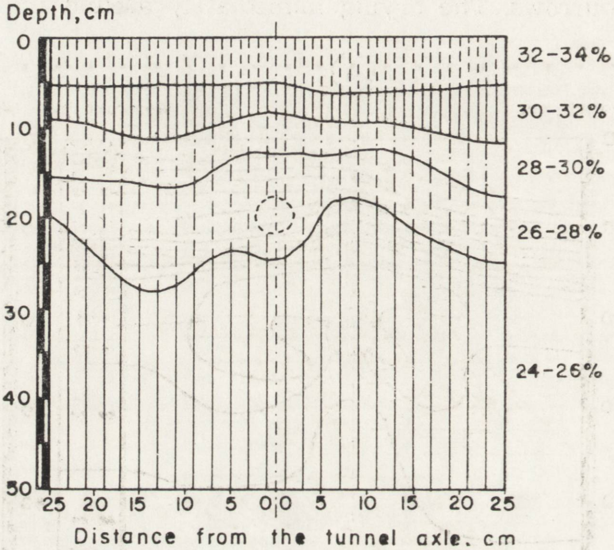

Fig. 2. Soil moisture distribution in the tunnel cross-section several days after rainfall (% weight).

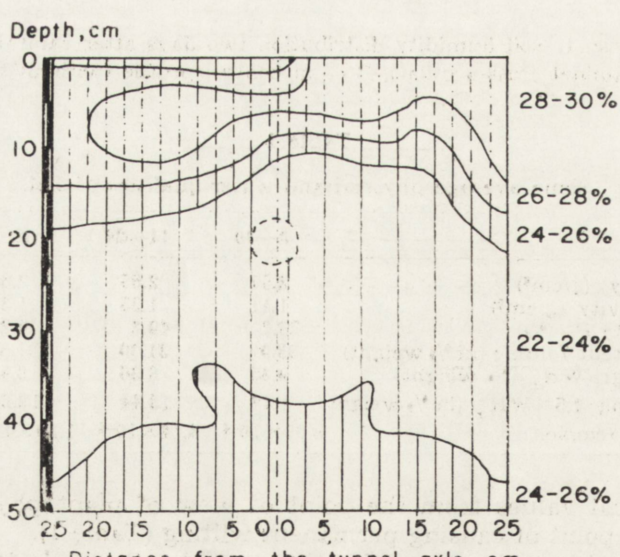

Fig. 3. Soil moisture distribution in tunnel cross-sections during the rainless period.

are dried up, yet considerable drying of the layers above the burrow and soil humidification below it may occur constantly.

The moisture of soil layers taken in succession after long-lasting rainfalls (Fig. 4) is greatest at the depth of 10 cm in places without hills and burrows. The soil under hills and in the neighbourhood of the tunnels has lower moisture than that in control (away from burrows) places, which emphasizes the drying role of tunnels. At the depth of 20 cm moisture increase is observed at tunnel ends, suggesting that soil layers may be humidified by water running along and seeping from

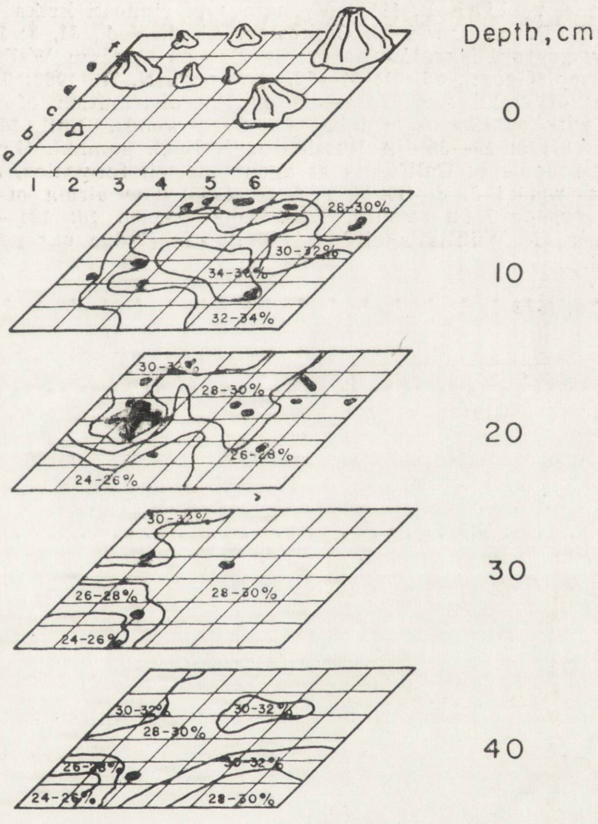

Fig. 4. Soil humidity distribution immediately after continuous rainfall, at 10 cm soil layer intervals.

tunnels. Lower soil moisture near the vertical tunnels is also observed. At 30 cm some balance of moisture is observed and it increases only under vertical tunnel ends. At 40 cm a general increase of moisture is observed when compared with the layer above. This is explained by the ground water cozing. Moisture between 30—32% of weight found in some zones may indicate, the watering influence of mole tunnels.

It may therefore be concluded that the presence of mole tunnels has a drying influence on the adherent soil layers both in the postdry period and after rainfalls. Drying around burrows may reach the point of inducing permanent plant wilting. Under tunnels running horizontally and under the closures of vertical tunnels local soil humidification was observed directly after rainfall. Thus overlapping of drying us humidification effects with a general tendency towards drying was observed.

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Accepted, April 9, 1976.