Pedobiologia **49** (2005) 61—67

ELSEVIER

Available online at www.sciencedirect.com

SCIENCE DIRECT

Pedo biologia

www.elsevier.de/pedobi

Feeding preferences among dark pigmented fungal taxa ("Dematiacea") indicate limited trophic niche differentiation of oribatid mites (Oribatida, Acari)

Katja Schneider*, **Mark Maraun**

Technische Universität Darmstadt, Institut für Zoologie, Schnittspahnstrasse 3, 64287 Darmstadt, Germany

Received 16 April 2004; accepted 30 July 2004

KEYWORDS
Oribatid mites;
Dematiacea;
Fungi;
Feeding preference;
Diversity

Summary

Trophic niche differentiation may explain the high diversity of soil animal species. However, trophic niches of soil invertebrate species are little understood and it appears that different decomposer soil animal species prefer similar food substrates. Soil microarthropods, such as collembolans and oribatid mites, preferentially feed on dark pigmented fungi ("Dematiacea") but their feeding preferences among different dark pigmented fungal species are little studied. In this study, we offered eight dark pigmented fungal taxa (*Alternaria alternata*, *Bipolaris spicifera*, *Chloridium* sp., *Cladosporium* sp., *Codinea* sp., *Oidiodendron* sp., *Phialophora verrucosa*, *Ulocladium* sp.) and two little pigmented fungal species (*Aureobasidium pullulans* and *Mortierella ramanniana*) to 10 species of oribatid mites. Despite the overall trend of oribatid mites to prefer two of the dark pigmented fungi (*Alternaria alternata* and *Ulocladium* sp.), feeding preferences significantly differed between the oribatid mite species. *Achipteria coleoptrata*, *Carabodes* sp., *Liacarus subterraneus*, *Oribatella quadricornuta* and *Steganacarus magnus* strongly preferred *Alternaria alternata* and *Ulocladium* sp.; *Hypochthonius rufulus* preferred *Phialophora verrucosa*. Species with low feeding preferences, *Eupelops torulosus* and *Oribatula tibialis,* preferentially fed on *Ulocladium* sp. and *Codinea* sp., respectively. The other species (*Nothrus silvestris*, *Platynothrus peltifer*) had no clear feeding preferences. The results support that trophic niche differentiation in oribatid mite species is limited, but may contribute to the high diversity of soil animal species.

---

*Corresponding author.
E-mail address: schneider@bio.tu-darmstadt.de (K. Schneider).

0031-4056/$ - see front matter © 2004 Elsevier GmbH. All rights reserved.
doi:10.1016/j.pedobi.2004.07.010

Introduction

Oribatid mites are among the most abundant and diverse microarthropods in forest soils. Their densities in forest floors of the temperate region range between 20,000 and 400,000 ind m^{-2} with a high alpha diversity but a low beta diversity (Maraun and Scheu, 2000). The high diversity of oribatid mites (60–120 species per site), and decomposer soil animals in general, is one of the great riddles in soil ecology (Anderson, 1975a; Schaefer, 1991). Anderson (1975a) proposed three hypotheses to explain soil animal species diversity: (1) food for soil animals is available in excess and therefore competition for food is limited, (2) species are separated by colonizing different microhabitats or (3) species use different food resources. There is no evidence supporting the first hypothesis rather, theoretical and experimental evidence suggest that food resources in soil are of limited supply (Slobodkin et al., 1967; Scheu and Schaefer, 1998).

Oribatid mites live in very different microhabitats, e.g. in the litter layer, the humus layer, in dead wood, in moss and in the bark of trees, and this contributes to the high diversity of oribatid mites (Aoki, 1967; Hammer, 1972; Wunderle, 1992; Hansen, 2000). Furthermore, Anderson (1973) has shown that the litter layer in mixed deciduous woodland forms a mosaic of microhabitats in time and space and this may allow more species to coexist. From the perspective of minute soil invertebrates one layer of the soil profile consists of a large number of "compartments" each consisting of a range of different habitats.

Food specialization remains a key issue for understanding animal species diversity in soil. Even small differences in food preferences of oribatid mites may reduce competition between species. Surprisingly, knowledge on feeding biology of many soil invertebrates is poor and the available information in part is contradictory. Gut content analyses and analyses of enzyme activity indicate that most oribatid mites ingest a wide range of food materials including spores and hyphae of various fungal species, plant material, conifer pollen and parts of animal bodies (Luxton, 1972; Behan and Hill, 1983; Siepel and de Ruiter-Dijkman, 1993). In contrast, food choice experiments suggest that oribatid mites preferentially feed on fungal species (Mitchell and Parkinson, 1976; Kaneko et al., 1995; Maraun et al., 1998a). Recent studies on the natural variation in stable isotope ratios ($^{15}N/^{14}N$) indicate that oribatid mites use very different food resources ranging from plant material to animal tissue (Schneider et al., 2004).

More detailed knowledge on the feeding biology of oribatid mites is necessary for understanding niche differentiation between species but it is also important for understanding the effect of oribatid mites on the community structure of fungi in soil. Grazing on fungi by oribatid mites has been found to affect the fungal community in some studies (Maraun et al., 1998b) but not in others (McLean et al., 1996). Furthermore, knowledge on the feeding biology of oribatid mites is important to understand to what extent soil microarthropods are limited by the availability of food resources (bottom-up control). Additionally, understanding co-evolutionary interactions between soil fungi and soil microarthropods may contribute to uncover the forces which were responsible for the evolution of the high number of oribatid mite species (Bernini, 1986; Norton et al., 1993; Maraun et al., 2003).

This study adds to previous investigations on food preferences of oribatid mites by investigating different species of dark pigmented fungi since little is known on food preferences of oribatid mite species for different dark pigmented fungal taxa. We hypothesize that selective feeding by oribatid mite species on different species of "Dematiacea" contributes to the high diversity of oribatid mites.

Materials and methods

In May 2002 oribatid mites were extracted by heat (Kempson et al., 1963) from the soil of a beech-oak forest near Darmstadt (Kranichsteiner Wald, Hesse, Germany). The following 10 oribatid mite species colonising the litter layer were collected: *Achipteria coleoptrata*, *Carabodes* sp., *Eupelops torulosus*, *Hypochthonius rufulus*, *Liacarus subterraneus*, *Nothrus silvestris*, *Oribatella quadricornuta*, *Oribatula tibialis*, *Platynothrus peltifer* and *Steganacarus magnus*.

Ten fungal species were offered as food substrates simultaneously to single species of oribatid mites: *Alternaria alternata*, *Bipolaris spicifera*, *Chloridium* sp., *Cladosporium* sp., *Codinea* sp., *Oidiodendron* sp., *Phialophora verrucosa*, *Ulocladium* sp. (all "Dematiacea"), *Mortierella ramanniana* (Zygomycetes) and *Aureobasidium pullulans* (Moniliales). The fungal species were extracted from leaf litter material (beeck-oak) of the Kranichstein forest near Darmstadt (Germany). They were stored in the laboratory until the beginning of the experiment. Two weeks before the start of the experiment they were freshly inoculated on malt extract agar (2%). Species names of the fungi are subsequently abbreviated as genera names.