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Research Article

Biodiversity of oribatid mites in two different microhabitats of Khuzestan province (Southwestern Iran)

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Abstract: Two different microhabitats (cropped fields versus established date-palm farms) in two different cities in Khuzestan Province, Southwestern Iran, were sampled monthly during 2011-2012 in order to assess the role of anthropic uses of soil on the biodiversity of oribatid mites. A total of 17 species of oribatid mites belonging to 10 families and 15 genera were identified (nine species were collected from the fields and 17 species were collected from date-palm farms). Among the collected species, *Scheloribates fimbriatus* with 22% relative abundance and *Acrotritia ardua* with 19% were dominant species. The Shannon index of species diversity and equitability was used to analyze data. Species diversity of oribatid mites and equitability were significantly greater in the date-palm farms than in the cropped fields. Time of year had no significant effect on biodiversity.

Keywords: Acari, Oribatida, Biodiversity, Date-Palm, Equitability

Introduction

Soil is one of the most biologically diverse habitats on the planet and the organisms which live in soil are essential to our well being (Curry, 1986). Although most of the organisms are invisible to the naked eye, they all contribute to keeping our soil healthy and to sustaining life (Curry, 1986). An increasing loss of habitat and biodiversity, worldwide, necessitates assessing biodiversity when planning conservation strategies (Gulvik, 2007; Curry, 1986). Human activity and land management affect both populations of soil organisms and the equilibrium of the environment by altering the quality and quantity of detritus and non-detritus inputs and by influencing the physical and chemical qualities of soil microhabitats (Gulvik, 2007; Curry, 1986). Furthermore, soil is an important component for monitoring land usage in relation to both the conservation of natural resources and the biodiversity of ecosystems (Seastedt, 1984). Cultivation practices have a strong influence on the diversity and abundance of soil fauna with soil microarthropods having a vitally important role in ecosystem processes such as the decomposition of organic matter and nutrient mineralization (Seastedt, 1984). In most habitats oribatid mites account for the greatest proportion of microarthropods. They can be found in most terrestrial microhabitats: soil, leaf-litter, moss, under wood and foliage, as well as in aquatic habitats, usually in great species richness and abundance (Behan-Pelletier, 1999). As such, and owing to their species diversity, high population densities and sensitivity to environmental changes, they are

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considered suitable indicators of soil systems (Okiwelu *et al*., 2011).

It is known that all types of human disturbances decrease the abundance and species richness of mites, especially of oribatids (Gulvik, 2007) and, as this group plays a significant role in soil processes, it is necessary to be able to understand the effects of agricultural practices on their population and species richness. With this in mind we set out to examine differences in the diversity of oribatid mites in soil that was being actively farmed (cropped fields) and soil that was not (an abandoned date-palm orchard) in Khuzestan province, Southwestern Iran. We report here the results of this investigation into the effect of human disturbances on the biodiversity of soil micro-arthropods, the first to be undertaken in Khuzestan.

Materials and Methods

Study area

Mollasani and Ramhormoz (Khuzestan province) in Southwestern, Iran with warm and dry climate were chosen for study. Two sites were selected in each city, actively cultivated field and an abandoned date palm farm. Random samples from the surface to a depth of 15 cm of soil were collected monthly with three replicates at each site from January 2011 to December 2012. Samples were collected by use of a small shovel and transported to the laboratory at the Ramin University of Khuzestan. Mites were extracted using a modified Berlese-Tullgren funnel (Coleman *et al.*, 2002), and stored in 75% ethanol or cleared in lactophenol and fixed in Hoyer's medium on micro slides. The species were identified by use of available keys (Akrami and Saboori, 2012; Krants and Walter, 2009) and then were sent to Louise Coetzee (Natural Museum Bloemfontain, South Africa) for more identification and confirmation.

Data analysis

Shannon-Wienner index was calculated for all samples using SDR version 4 software (Species Diversity and Richness, V.4) (Seaby and Henderson, 2006). The Pielou's evenness index was used to analyze the evenness of each community. The evenness (range 0-1) is a measurement of population-balance in sites, with values ≥ 0.8 indicating optimum population balance (Magurran, 1988). The diversity types used were diversity per season and year:

$H' = -\Sigma\, p_i \ln p_i$

where Pi is the proportion of individuals found in the *i*th species.

Differences in diversity between two different microhabitats (date-palm and cropped field) and between different seasons, were analyzed by one-way analysis of variance (ANOVA) using SDR software. A test at $p < 0.5$ was used to confirm statistically significant differences in biodiversity between the two microhabitats.

Results

We sampled 2 sites (Ramhormoz and Mollasani) and 2 microhabitats (Cropped field and date-palm) at each location every month and assessed oribatid mites over two years and for each of the four yearly seasons (Table 1). A total of 3621 oribatid mites belonging to 10 families, 15 genera and 17 species were collected from the two microhabitats. Of the 17 species, 16 were present in samples collected from the date-palm farms and eight from the actively cultivated cropped fields (Table 3).

Species diversity (*H'*) and equitability (*j*) at the four microhabitats are shown in Table 1. Differences in diversity index and equitability between the two different microhabitats (date-palm and cropped field) were investigated using ANOVA. The results revealed significant differences in species diversity and equitability for the two microhabitats (p = 0.0001). Species diversity and equitability were significantly greater in the date-palm farms than in the cropped fields (t = 9.93**, df = 30; t = 5.045**, df = 30; for *H'* and *J* indices, respectively). Such results have been observed in other, similar studies (Cancela da

Fonseca and Sarkar, 1998; Arroyo and Iturrondobeitia, 2006).

Although Arroyo and Iturrondobeitia (2006) observed that the diversity of oribatid mites was slightly greater in autumn than in spring, Gergocs *et al.* (2011) were unable to confirm that climatic differences and differences in other seasonally changing factors have a significant role in any annual change in oribatid mite diversity. We, also did not detect any differences due to the effect of winter, spring, summer and autumn on diversity of oribatid mites at the two different microhabitats ($t = 0.298^{ns}$, df = 14) (Table 2).

It is known that the Oribatida is a dominant group in soils with higher organic matter content. They are also more abundant in undisturbed soils such as those at the date-palm farms we studied. The trees were more than 50 years old, and the soils are high in organic matter while chemicals had not been applied for several years. This might explain the different diversity of oribatid mites observed in the two microhabitats. In general, agricultural practices, such as plugging, the application of agrochemicals and flood irrigation result in a decrease in species diversity such as those observed for Oribatida, where active cultivation and application of insecticidal materials are being practiced (Cancela da Fonseca and Sarkar, 1998; Arroyo and Iturrondobeitia, 2006).

Table 1 Species diversity and Evenness of oribatid mites in two microhabitats at different cities in different seasons during 2011-2012.

Sampling site	Habitat type	Index	2011				2012				
			Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	All sample index ± SE
Ramhormoz	field	*H'*	1.20	0.97	1.60	1.70	1.20	1.60	1.00	1.49	1.68 ± 0.11
		J	0.30	0.20	0.64	0.69	0.44	0.71	0.25	0.70	0.54 ± 0.11
	Date-Palm	*H'*	2.19	2.31	1.99	2.28	2.29	1.86	2.21	2.15	2.26 ± 0.03
		J	0.83	0.87	0.79	0.88	0.84	0.74	0.86	0.83	0.81 ± 0.03
Mollasani	field	*H'*	1.51	1.17	1.75	0.88	1.54	0.84	1.09	1.5	1.53 ± 0.14
		J	0.79	0.69	0.77	0.56	0.78	0.53	0.52	0.72	0.83 ± 0.03
	Date-Palm	*H'*	2.19	2.31	1.99	2.28	2.29	1.86	2.21	2.15	2.18 ± 0.06
		J	0.83	0.87	0.79	0.88	0.84	0.74	0.86	0.83	0.81 ± 0.03

H': Shannon-Wienner index, *J*: Pielou's evenness index.

Table 2 Summery statistics of one-way ANOVA by different seasons.

Entries	Source of variation	df	Mean Square	*F*-ratio	*p*-value.
Species diversity	Between Groups	3	0.063	0.242	0.866
	Within Groups	28	0.259		
	Total	31			
Evenness	Between Groups	3	0.013	0.349	0.790
	Within Groups	28	0.037		
	Total	31			

Table 3 Species of oribatid mites collected from two different microhabitats during 2011-2012 and their abundance.

Species	Mollasani				Ramhormoz				Total	
	Ab-F	RA% F	Ab-D	RA% D	Ab-F	RA% F	Ab-D	RA% D	Ab	RA%
Acrotitia ardua Koch	0	0.0	162	0.13	0	0.00	537	0.30	699	0.19
Acrotritia sinensis Jacot	0	0.0	68	0.05	0	0.00	88	0.05	156	0.04
Lohmannia turcmenica Bulanova-Zachvatkina	0	0.0	8	0.01	0	0.00	21	0.01	29	0.01
Papilacarus chamartinensis Pérez-Íñigo	21	0.1	39	0.03	18	0.07	53	0.03	131	0.04
Crypacarus promecus Grandjean	12	0.0	0	0.00	9	0.04	0	0.00	21	0.01
Epilohmannia cylindrical Berlese	36	0.1	66	0.05	8	0.03	211	0.12	321	0.09
Epilohmannia inexpectata Schuster	0	0.0	15	0.01	0	0.00	2	0.00	17	0.00
Nothrus anauniensis Canestrini & Fanzago	0	0.0	7	0.01	0	0.00	6	0.00	13	0.00
Tectocepheus velatus Michael	18	0.1	63	0.05	41	0.17	52	0.03	174	0.05
Microppia minus longisetosa Subias & Rodriguez	31	0.1	36	0.03	15	0.06	71	0.04	153	0.04
Multioppia wilsoni Aoki	0	0.0	6	0.00	0	0.00	0	0.00	6	0.00
Lasiobelba neonominata Subias	107	0.3	147	0.11	74	0.30	170	0.10	498	0.14
Discoppia cylindrical Pérez-Íñigo	0	0.0	75	0.06	0	0.00	64	0.04	139	0.04
Scheloribates fimbriatus Thor	49	0.2	396	0.31	73	0.30	291	0.17	809	0.22
Oribatula connexa ucrainica Iordansky	15	0.0	12	0.01	0	0.00	3	0.00	30	0.01
Zetomotrichus Lacrimans Grandjean	30	0.1	174	0.13	9	0.04	173	0.10	386	0.11
Galuma iranensis Mahunka & Akrami	0	0.0	18	0.01	0	0.00	21	0.01	39	0.01
Total	319	1.0	1292	1.00	247	1.00	1763	1.00	3621	1.00

Ab = abundance (number of individuals), RA = relative abundance, F = field, D = date-palm.

Discussion

We conclude from the results presented here that soils under cropping systems recorded lower mites abundance and diversity compared to the less disturbed soils, Because In our study, cropped fields involved continued cultivation of soil for planting and weed control that are likely to have negative effects on soil organisms. Hülsmann and Wolters (1998) found that tillage has adverse effects on soil mites with 50% reduction in population immediately after tillage. Also, Arroyo and Iturrondobeitia (2006) suggested that traditional agricultural practices such as use of non-organic, wastes amendments, inorganic fertilization, use of agrochemical products and burning of crop residues after harvest may have a negative effect on soil leading to biodiversity decrease. The date-palm microhabitats had higher oribatid mite abundance, richness and diversity than cropped fields possibly due to low disturbance which ensures stable litter layer and suitable micro-climate. Rodriguez *et al*., (2006) found arthropod abundance in agro ecosystem as well as under zero-tillage to be higher than under conventional tillage due to presence of surface residue. The uncultivated soils with plant residue cover provide a readily available food resource and moderate the effect of extreme temperatures, also reduce the rate of moisture loss from the soil surface (Coleman *et al*., 2002; Bedano *et al*., 2006).

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تنوع زیستی کنه‌های اریباتید (Acari: Oribatida) در دو خرد زیستگاه متفاوت در استان خوزستان (جنوب غرب ایران)

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چکیده: به‌منظور ارزیابی نقش دخالت‌های انسان در تنوع زیستی کنه‌های اریباتید در خاک، دو زیستگاه کوچک شامل یک مزرعه و یک نخلستان در شهرستان‌های رامهرمز و ملاثانی (استان خوزستان) انتخاب شد و از دی‌ماه سال ۱۳۹۰ تا دی‌ماه سال ۱۳۹۱ به‌طور مرتب و هر ماه یک‌بار از خاک این مناطق نمونه‌برداری به‌عمل آمد. در مجموع ۱۷ گونه متعلق به ۱۰ خانواده و ۱۵ جنس جمع‌آوری و شناسایی گردید (۹ گونه از مزرعه و ۱۷ گونه از نخلستان) که در میان آنها گونه‌ی *Scheloribates fimbriatus* با فراوانی نسبی ۲۲٪ و گونه‌ی *Acrotritia ardua* با فراوانی نسبی ۱۹٪ به‌عنوان گونه‌های غالب شناسایی شدند. به‌منظور ارزیابی تنوع زیستی و یکنواختی کنه‌های اریباتید در خاک از شاخص‌های تنوع شانون و یکنواختی پائولا استفاده شد. نتایج نشان داد که تنوع زیستی و یکنواختی کنه‌های اریباتید در نخلستان‌های مورد بررسی به‌طور معنی‌داری بالاتر از مزارع می‌باشد. همچنین بررسی اثر فصول مختلف سال بر تنوع زیستی نشان داد که تغییرات آب و هوایی در فصول مختلف سال اثر بارزی بر تنوع زیستی کنه‌ها در مناطق مورد بررسی ندارد.

واژگان کلیدی: کنه‌های اریباتید، نخلستان، تنوع زیستی، یکنواختی