DISTRIBUTION OF SOIL MITES AND COLLEMBOLANS UNDER PINE TREES IN RIYADH REGION, SAUDI ARABIA

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Synopsis

AL-KHALIFA, M. S. and B. M. BAYOUMI (Zoology Department, College of Science, King Saud University, Riyadh, Saudi Arabia): Distribution of soil mites and collembolans under pine trees in Riyadh region, Saudi Arabia. *Acta arachnol.*, 32: 27-36 (1983).

The seasonal and vertical distribution of soil mites and collembolans under pine trees in four sites of different soils at Riyadh region were investigated. A total of 40 species of Acari and 6 species of Collembola have been identified. Seasonal and vertical differences in population density in the four sites were discussed.

Introduction

Soil mites and collembolans are considered the most important decomposers among the soil fauna. Much work has been done on these animals in various parts of the world. However, arid and semi-arid ecosystems have received scant attention from zoologists. This includes works published by EL-KIFL (1957), MOURSİ *et al.* (1971), KOLKAILA *et al.* (1971) and HAMMAD *et al.* (1975).

To our knowledge, the only ecological study on the population dynamics of soil arthropods in the Arabian Peninsula was done by HAMMAD *et al.* (1980). The aim of the present article is to investigate the distribution and dynamics of soil mites and collembolan populations under the widely distributed pine trees, *Tamarix nilotica* L., in Riyadh region.

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The Sample Sites and Methods

The study was conducted in four localities within the Riyadh region, representing communities dominated by pine trees, *T. nilotica* L. (Fig. 1). A brief description of the sampling sites is given below:

Fig. 1. Map of Saudi Arabia showing the sampling localities (inset: Riyadh region).

- A) *Al-Diriyah site*: It is a five acres orchard, with pine trees occupying about half an acre, and the ground vegetation is dominated by Alfalfa (*Medicago sativa* L.). The orchard receives farmyard manure twice a year, in summer and in winter. The soil is sandy clay, with pH of about 7.3.
- B) *Salbukh site*: This site is about one acre and was selected from a large orchard situated in Salbukh valley. Patches of *Trifolium* sp. are observed scattering at the sampling site during winter months. Farmyard manure is added in summer. The soil is sandy loam, with pH of about 7.1.
- C) *Al-Kharj site*: It is a fallow soil, sampling was performed on a strip of land along the edge of an irrigation ditch. Pine leaf litter is usually abundant on the soil surface. The soil is sandy clay, with pH of about 7.6.

D) *Durma site*: It is a desert soil, of about two acres area adjacent to a large farm, with no ground vegetation. The soil surface is covered with a thin layer (about 1 cm thick) of pine leaf litter. This site was planted with Alfalfa for grazing camels one year before sampling. The soil is sandy, with pH of about 7.9.

The sites were sampled on four occasions: June, October 1981; January and April 1982. Four soil samples per site were randomly collected on each occasion.

Fig. 2. Air temperature and rainfall during the investigation period.

Table 1. Mean moisture percentages, temperatures and organic matter contents of the tested soils.

Month	Depth in cm	Soil Moisture (%)				Soil Temperature (°C)				Organic matter (%)			
		A	B	C	D	A	B	C	D	A	B	C	D
June 1981	0-5	2.5	3.1	2.4	1.0	24.0	23.0	28.0	21.8	3.0	2.4	1.1	0.8
	5-10	2.2	3.3	3.0	1.1	23.7	22.5	27.0	21.6	3.9	2.6	1.3	0.6
October 1981	0-5	2.0	3.4	2.0	0.8	25.0	18.0	20.0	20.5	3.5	2.7	1.3	0.6
	5-10	2.3	3.5	2.2	0.7	22.5	18.0	19.0	19.5	3.6	2.9	1.5	0.7
January 1982	0-5	3.2	4.2	2.5	2.0	17.0	12.0	16.0	10.0	3.1	2.9	1.6	0.7
	5-10	3.0	4.5	2.7	2.5	18.0	12.0	15.2	9.2	3.2	2.8	1.8	0.9
April 1982	0-5	2.6	5.0	3.0	1.8	22.2	21.1	23.1	19.3	3.8	3.7	1.2	0.6
	5-10	2.2	4.8	2.8	1.6	20.1	20.7	22.3	19.2	3.1	3.2	1.0	0.7

A: Al-Diriyah B: Salbukh C: Al-Kharj D: Durma

Animals were extracted from quadrangular metal cores (10×10×5 cm) using a modified Tullgren's funnel (BALOGH, 1958).

The physical properties of soil samples which were dealt with in the present investigation included: moisture content (% of dry weight), soil temperature, organic matter % (loss by ignition) and pH (see Table 1). Data for rainfall and air temperature during the investigation period are presented in Fig. 2.

Results

Faunistic composition: A total of forty acarine species and six collembolan ones were identified from the four sites (Table 2). Among the acarine species, only four Cryptostigmata and two Prostigmata were recorded from all four sites. From the list presented in Table 2 it can be seen that Al-Kharj and Durma localities had 14 and 15 acarine species, and 1 and 2 collembolan ones, respectively; and were the poorest areas in this respect. Al-Diriyah locality supported the highest number of species of Acari and Collembola. There were 35 Acari found in this site, among them 23 Cryptostigmata, and 6 Collembola.

Seasonal variation in population density: It is evident from Table 3 that the highest population density of both Acari and Collembola occurred in Salbukh (89,700/m² and 31,300/m², respectively) and the lowest density of Acari was observed in Durma (10,900/m²). Collembolan population showed its lowest number (4,300/m²) in Al-Kharj. Generally, the collembolan populations were very much smaller than Acari in all sites examined.

Table 4 shows the break-down of the Acari data into groups. The Cryptostigmata comprised over 50% of all Acari in all sites. The highest percentage of mesostigmatid mites (24% of the total Acari) was found in Salbukh, where most Collembola occurred.

Although in this present work the animals were sampled only seasonally, peaks and depressions in population numbers were evident. Fig. 3 shows the seasonal variation in the number of all species of mites and collembolans in the four tested soils. In all sites, the Collembola showed a peak of greatest abundance during spring. In Salbukh locality, however, an additional peak was observed in winter. In Al-Diriyah and Durma localities the mite populations, which were primarily dominated by the Cryptostigmata, showed two main peaks of abundance, one during winter and the other during spring. In Salbukh and Al-Kharj, however, the mite populations showed a similar fluctuation pattern, but

Table 2. Faunal list of Acarina and Collembola for the four sample sites.

S P E C I E S	A	B	C	D
ACARINA				
CRYPTOSTIGMATA				
<i>Rhysotritia ardua</i> (KOCH)	+	+	+	+
<i>Heptacarus ornatus</i> BAYOUMI <i>et</i> AL-KHALIFA	+			
<i>Epilohmannia cylindrica cylindrica</i> (BERLESE)	+	+	+	+
<i>Epilomannia pallida aegyptica</i> BAYOUMI <i>et</i> MAHUNKA	+	+	+	
<i>Nothrus biciliatus</i> (KOCH)	+			
<i>Microzetes auxiliaris</i> GRANDJEAN	+			
<i>Tectocepheus velatus</i> (MICHAEL)	+	+	+	
<i>Striatoppia niliaca</i> (POPP)	+			
<i>Oppia bifidus</i> BAYOUMI <i>et</i> AL-KHALIFA	+			
<i>Oppia clavipectinata</i> (MICHAEL)	+	+		+
<i>Oppia foveolata</i> (PAOLI)	+	+	+	
<i>Oppia mihelcici</i> PÉREZ-IÑIGO		+	+	
<i>Oppia varians</i> WALLWORK	+			
<i>Oppiella nova</i> (OUDEMANS)	+	+		
<i>Oribatula tibialis</i> (NICOLET)	+			+
<i>Scheloribates fimbriatus africanus</i> WALLWORK	+			+
<i>Scheloribates laevigatus</i> (KOCH)	+	+	+	+
<i>Scheloribates pallidulus</i> (KOCH)	+	+	+	+
<i>Scheloribates saudicus</i> BAYOUMI <i>et</i> AL-KHALIFA	+			
<i>Xylobates capucinus</i> (BERLESE)	+	+		+
<i>Rostrozetes foveolatus</i> SELLNICK	+	+		
<i>Lamellobates hauseri aegypticus</i> BAYOUMI	+			
<i>Paralamellobates ceylanicus</i> (OUDEMANS)	+			
<i>Galumna flabellifera</i> HAMMER	+		+	
Total number of cryptostigmatid species	23	12	9	8
MESOSTIGMATA				
<i>Prozercon kochi</i> SELLNICK		+		+
<i>Parazercon sarekensis</i> WILLMANN		+		+
<i>Sejus serratus</i> (HALBERT)		+		
<i>Macrocheles apacus</i> (KOCH)	+		+	+
<i>Macrocheles subbadius</i> (BERLESE)	+			+
<i>Pergamasus longicornis</i> (BERLESE)	+	+	+	
Total number of mesostigmatid species	3	4	2	4

Table 2. (Contd.)

S P E C I E S	A	B	C	D
PROSTIGMATA				
<i>Raoiella indica</i> HIRST	+	+	+	+
<i>Cunaxa simplex</i> EWING	+	+	+	
<i>Cunaxa capreolus</i> (BERLESE)	+	+		
<i>Acropsis sollers</i> ROHDENDORF	+			
<i>Spinibdella bifurcata</i> ATYEO	+			
<i>Tydeus munsteri</i> MEYER et RYKE		+		
<i>Eutetranychus afriasiaticus</i> MCGREGOR	+	+	+	+
Total number of prostigmatid species	6	5	3	2
ASTIGMATA				
<i>Glycyphagus domesticus</i> (DE GEER)	+	+		
<i>Tyrophagus palmarum</i> (OUDEMANS)	+			+
<i>Schwiebia</i> sp.	+			
Total number of astigmatid species	3	1	0	1
Total number of acarine species	35	22	14	15
COLLEMBOLA				
<i>Hypogastrura manubrialis</i> (TULLBERG)	+	+	+	
<i>Hypogastrura armata</i> (NICOLET)	+	+		+
<i>Tomocerus minor</i> (LUB.)	+			
<i>Seminuthrus viridis</i> L.	+	+		+
<i>Entomobrya</i> sp.	+	+		
<i>Cyphoderus</i> sp.	+	+		
Total number of collembolan species	6	5	1	2

+ indicates that species recorded on that sample site.

A: Al-Diriyah B: Salbukh C: Al-Kharj D: Durma

Table 3. Populations of soil Collembola and Acari (in thousands/m²) of the four investigated localities. The data are the means and standard errors of 16 soil cores.

Site	Collembola	Acari	Total
Al-Diriyah	15.5±1.18	76.3±7.33	91.8± 8.51
Salbukh	31.3±2.13	89.7±9.62	121.0±11.75
Al-Kharj	4.3±0.90	33.7±5.11	38.0± 6.01
Durma	8.4±2.71	10.9±1.56	19.3± 4.27

Table 4. Soil Acari populations (in thousands/m²) of the four investigated localities. The data are the means and standard errors of 16 soil cores, and the percentage of each suborder of the total Acari are given.

Site	Cryptostigmata	Mesostigmata	Prostigmata	Astigmata	Total Acari
Al-Diriyah	66.4±5.90	2.6±0.42	6.5±0.80	0.8±0.21	76.3±7.33
%	87.02	3.41	8.52	1.05	
Salbukh	58.7±4.20	21.7±3.00	6.4±1.60	2.9±0.82	89.7±9.62
%	65.44	24.19	7.13	3.23	
Al-Kharj	29.1±3.62	3.7±1.05	0.9±0.44	—	33.7±5.11
%	86.35	10.98	2.67		
Durma	8.7±0.83	1.3±0.45	0.7±0.21	0.2±0.07	10.9±1.56
%	79.82	11.93	6.42	1.83	

with a third peak found in autumn.

In all sites the Cryptostigmata was most dominant during winter and spring. The Mesostigmata, Prostigmata and Astigmata did not show any seasonal fluctuation in all investigated localities, although the number of mesostigmatid mites in Salbukh showed an increase during autumn.

Vertical migration: The seasonal population changes in depth distribution are given in Fig. 3. In all sites and during the seasons investigated, cryptostigmatid mites were generally found to inhabit the 5–10 cm level of soil. However, during spring in Al-Diriyah, Al-Kharj and Salbukh, they were dominant in the 0–5 cm soil layer. The other suborders of Acari showed no significant changes in depth distribution in all sites.

Collembolans were rare in both layers of soil during summer in all localities, except in Salbukh where they were most abundant in the 0–5 cm level. During autumn and winter the collembolan population migrated downwards to the 5–10 cm depth in all localities. During spring, however, they were almost equally distributed in both layers of soil in Al-Diriyah and Al-Kharj, but there was a detectable upward migration in Salbukh and Durma.

Discussion

Many investigators have noticed that the suborder Cryptostigmata dominates other mite suborders. The same was also observed in the present study, where the number of cryptostigmatid species and individuals were found to be the largest among mite populations. The abundance of cryptostigmatid mites, especially in

Fig. 3. Population dynamics of Acarine Suborders and Collembola in the four localities. (+ indicates that mean population is less than 200 ind./m²)

Al-Diriyah locality, could be attributed to the rich organic matter content of the soil. This agrees with the finding of LOOTS and RYKE (1967) and HAMMAD *et al.* (1971) who reported that cryptostigmatid mites mostly dominate in soils that are rich in organic matter. A further support to this concept is the finding, in the present study, of a poor population density of these mites in Durma locality, where the organic matter content was the lowest.

In general, the nature of soil and its ground vegetation seem to highly influence the population density of Acari and Collembola. Sandy soils where ground vegetation is absent such as the one in Durma locality, for instance, were found to be unsuitable for either mites or collembolans.

A comparison between the population density estimates presented in this study with data obtained by other investigators in other arid ecosystems may prove to be difficult because of the different nature of soil and vegetation cover. The winter and spring peaks of acarine and collembolan populations observed in all examined sites were expected because of the optimum microenvironmental conditions of the soils, especially its moisture content and temperature at that time of the year. Similar population peaks were observed by KOLKAILA *et al.* (1971) in their investigation of arthropods in some Libyan soils; and also by HAMMAD *et al.* (1980) under date-palm trees in the Eastern Province of Saudi Arabia. Furthermore, MADGE (1969) indicated that the number of invertebrates, in general, decreases drastically in the dry season as compared with the wet season in forest and savanna soils.

The vertical migration of soil mites and collembolans under arid conditions appears to be governed mainly by the soil temperature and its moisture content. The indication from the present study is that the animals prefer the more constant microenvironment in the deeper soil layer (5-10 cm depth), especially during the dry summer period.

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