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Full Length Research Paper

Study of the wildlife acarology (Acari: Oribatida) in the palm groves of Biskra

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This study, conducted in the region of Biskra, allows to define eight species of oribatid living in two palm groves of 7 and 10 years, seven species in palm groves of one and three years and finally, three species in a palm grove of five years. No species has been found in the witness palm grove. The prevailing species in all these palm groves is *Scheloribates* sp. with 450 individuals. This study shows that man's influence can be beneficial to the natural environment. Indeed, installing an oasis helps both modify the Saharan landscape and create a specific biotope that allows ground-acari to thrive. This biotope is characterized by a multitude of ecological factors that are of a great importance for these acari, they are mainly the microclimate and the feeding support.

Key words: Oribatida, palm groves, Biskra, ecological factors, oasis ecosystem, nutritional substrate.

INTRODUCTION

Semi-arid, arid, and Saharan regions are characterized by soils with variable temperature degrees that can reach very high levels. These soils will provide unfavorable conditions for the development of mites. Date palms are very important components in these settings. Their spread in almost all oases made them an important element of the landscape of these regions. Date palms are formidable ecological barriers against desertification, and the establishment of an agricultural oasis ecosystem allows a recovery of economic and ecological environments, and a gradual recovery of land and dry areas. The introduction of this tree that is associated with other trees, vegetables, and forages, forms the agricultural oasis system. Such a system will typically create an environment where ecological and environmental conditions are much better. The diversity of plant resources in palm groves are a very important ecological factor (Dajoz, 1970).

Microclimate, irrigation, and soil amendments are used to continuously provide an environment that is conducive to the development of mites. Mites require a number of factors for a favorable environment for development to be there. The abundance, species distribution, and community structure of arthropods depend on biotic and abiotic conditions of the environment (Tousignat and Coderre, 1992). Also, environmental factors determine the distribution and multiplication of soil mites (Vikram, 1986). Many studies have been made in these areas, particularly those related to diseases and parasites (Toutin, 1977), and date palm arthropod fauna (Achoura, 2010; Hamdi, 1992), but studies on soil fauna acarology, however, remain a very poorly studied area. In this study, the impact of oasis agroecosystem on the evolution of oribatid will be investigated.

MATERIALS AND METHODS

Region of study

The study was conducted in the region (Daira) of Tolga in the wilaya of Biskra on presenting palm plantation with different ages thus providing different microclimatic and edaphic characteristics very different. The Daira of Tolga covers 1,334.10 km^2 which is 6.20% of the total area of the prefecture (21,510 km^2), Utilized Agricultural Area (UAA) represents 8.89% of the total agricultural area (SAT) (9,250 ha, of which 74.87% is date palm). The rest consists of uncultivated land and grassland meadow that cover 91% of the SAT. Tolga is located 390 km south-east of the capital

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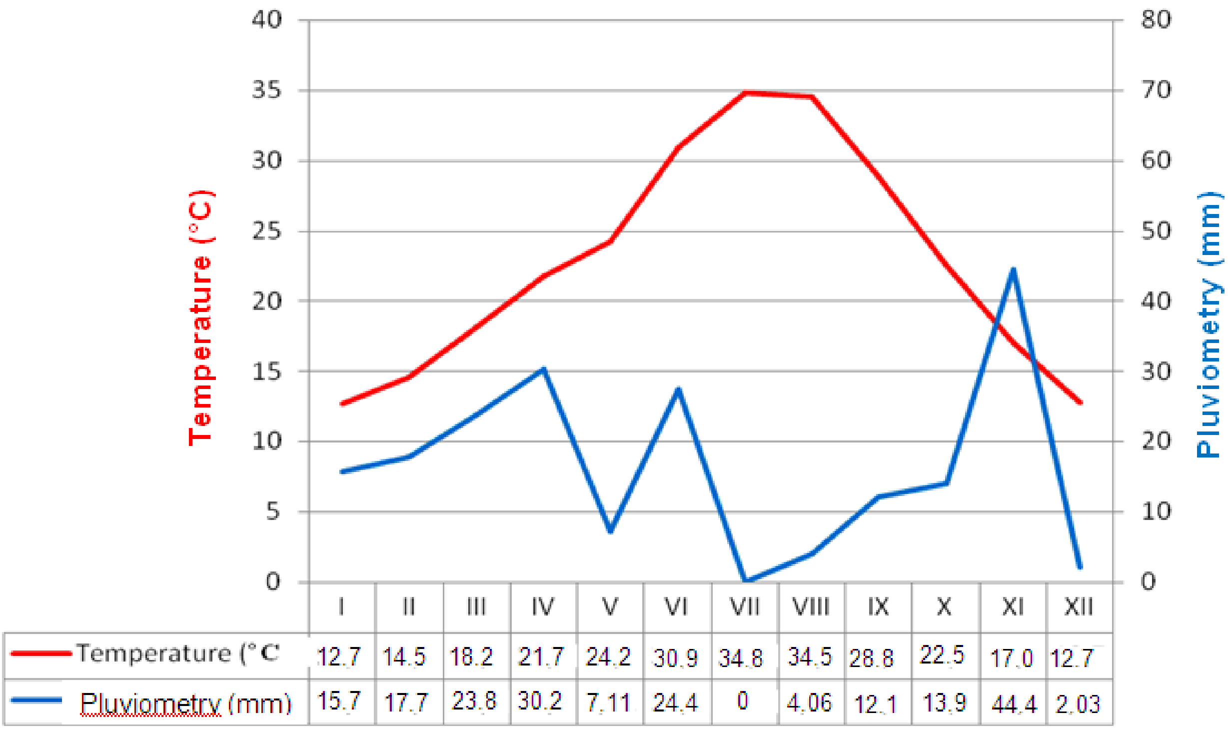

Figure 1. Climate data and ombrothérmic diagram of Biskra region in 2010.

Table 1. Relative humidity in the region of Biskra.

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
H (%)	55.7	52.1	44.4	46.3	33.9	32.5	26.6	32	39.5	43.9	57.9	48.6

(Algiers) and 36 km northwest of the capital of Biskra wilaya. Its altitude is 128 m above sea level. It is characterized by cold winters, hot and dry in summer. Its geographical location makes it a region-oriented agro-Saharan Africa based on the vast areas of the oasis. The activity of date palm cultivation is an important component of this region, and it appears as one of the most important regions suitable for palms in Algeria. Daira of Tolga is well known worldwide for the high quality of its dates, including the noble variety “Deglet Nour.”

Date palm crops

Manure fertilization is practiced by all farmers to maintain yields. However, the amendment of the manure is given in small amounts, below the needs of the generally poor soil. In the palm explored, these inputs are 33 kg for manure, sometimes within three years. The adverse effect of climatic and soil factors on date palm prosperity in Sahara are mainly a function of water availability. However, irrigation of palm is designed to ensure the amount of water required for normal development of the trees throughout the year and especially during the summer seasons in which demands are at their greatest. No prophylactic measure was provided: lack of maintenance, neglect of cleanliness in the majority of palm and chemical control dates which is rarely performed.

Climatic data

Results obtained show that the total rainfall during the year 2010 reached 198.88 mm (Figures 1 to 4). A maximum of 44.45 mm was recorded during the month of November and a zero value for the month of July. January is the coolest month with an average temperature of 12.7°C. July, in the contrary, is the hottest month with an average temperature of 34.8°C. As shown in Table 1, the average relative humidity of the air was greater than 57.9% during the months of November and was less than 26.6% for the month of July. According to the value of Q2 (13.96) calculated over ten years (2000 to 2010), the region of Biskra is localized in the Saharan bioclimatic to temperate winter (Tables 2 to 4).

Methods

Methods used are to count the quantity and quality of mite species in the various stations whereas the following samples were taken randomly. Ten samples were established for each station with three replicates and a total of thirty samples per station thus 180 per season x 2 seasons totaling 360 samples for the duration of experimentation. Each sample was taken using a square (15×15 cm) and a depth of 10 to 15 cm. Sampling was conducted during the months of April (spring season) and November (fall season),

Table 2. Bioclimatic zones of the study area.

Region	P (mm)	M (°C)	m (°C)	Q_2	Bioclimatic zones
Biskra	139.92	40.91	6.54	13.96	Saharan bioclimatic to temperate winter

P (mm): Pluviometry; M (°C): Maximum température; m (°C): Minimum température; Q_2: Rainfall quotient.

Table 3. Acarology fauna collected in the various the palms of Biskra.

Palmeraies	Species	Number (Autumn)	Number (Spring)	Total
Witness	**0**	**0**	**0**	**0**
P1 (1 year)	*Oppia bicarinata*	15	22	37
	Oppia neerlandica	1	12	13
	Scheloribates sp.	18	35	53
	Phthiracarus nitens	3	5	8
	Paleacarus sp.	2	3	5
	Galumna sp.	0	4	4
P2 (3 years)	*Oppia bicarinata*	15	16	31
	Scheloribates sp.	15	23	38
	Phthiracarus nitens	1	3	4
P3 (5 years)	*Oppia bicarinata*	49	35	84
	Scheloribates sp.	56	69	125
	Phthiracarus nitens	5	5	10
	Paleacarus sp.	48	52	100
	Galumna sp.	45	63	108
	Epilohmannia aegyptica	1	2	3
	Haplochthonius variabilis	15	5	20
P4 (7 years)	*Oppia bicarinata*	34	46	80
	Oppia neerlandica	22	41	63
	Scheloribates sp.	53	68	121
	Phthiracarus nitens	4	2	6
	Paleacarus sp.	34	53	87
	Galumna sp.	25	38	63
	Epilohmannia aegyptica	18	14	32
	Haplochthonius variabilis	11	23	34
P5 (10 years)	*Oppia bicarinata*	48	63	111
	O. neerlandica	38	54	92
	Scheloribates sp.	45	68	113
	Phthiracarus nitens	7	2	9
	Paleacarus sp.	12	9	21
	Galumna sp.	42	47	69
	Epilohmannia aegyptica	8	7	15
	Haplochthonius variabilis	17	39	56

and during the years 2010 and 2011. In the laboratory, the extraction of acarofaune is performed using Berlese funnels method and flotation method. Microarthropods were sorted and identified to the families through the identification key proposed by Balogh (1972). This determination was then refined at the specific level with a collection of M. Niedbala and M. Wauthy (Natural History

Table 4. Eigen values to the formation of axes.

Axes	Eigen values	% of inertia	Cumulative (%)
Axe1	0.112	49.966	49.966
Axe2	0.086	38.375	88.341

Figure 2. Different stations (a, b, c, d, e, and f) selected for this study.

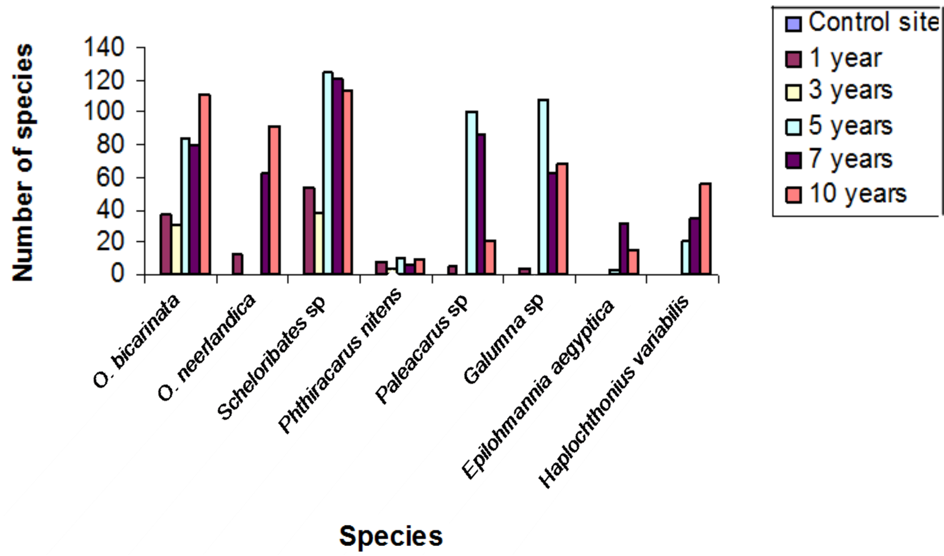

Figure 3. Evolution of species number according to palm age.

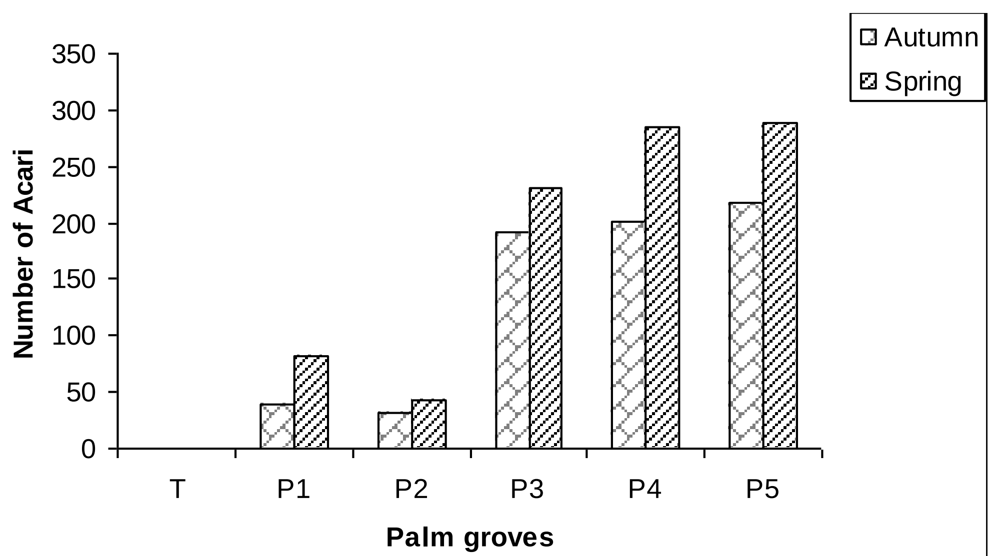

Figure 4. Number of mites collected in full and spring according to the different palm groves, the value of Khi² (G² Wilks) is equal to 0.024 which means that the distribution of mites on the basis of stations is highly significant.

Museum of Brussels, Belgium).

RESULTS

Factorial analysis of correspondence

The correspondence analysis (AFC) is used to describe the relationship between mite species and the different stations on the one hand and also between species. It is based on the absence (0) and presence (1) of mite species in the different stations. In the interpretation of the AFC, species and statements with relatively high concentrations were used in the calculations. The interpretation of an axis was done on the elements that provide to the axis the largest contributions to the axis that explained the maximum of inertia of this axis. However, the elements that contribute most to the construction of the axis are those that deviate from their origin, therefore they will present the highest coordinates. Digital processing was focused on the analysis of statements giving frequencies of eight species in the stations representing the five stations of the region of Tolga.

The contribution of the axis 1 is in the range of 49.96%

Table 5. Contribution of the different stations in the formation of axes.

Palm groves	Axe 1	Axe 2
P1	3.23	33.71
P2	0.82	46.56
P5	58.88	0.22
P7	0.00	15.10
P10	37.07	4.41

and that of axis 2 is 38.37% (4). Thus, the 1×2 factorial design alone accounts for 88.34% of the total inertia. In addition to the best plane of projection of all the elements it is, it will be very interesting to interpret the factorial design. For the formation of axis 1, the station P1 contributes 3.23%, that of the station P2 with 0.82% (Table 5). The third station P3 with 58.88%, the fourth with 0.00% and the fifth with 37.07%. For axis 2, stations 1 and 2 contribute 33.71 and 46.56%, respectively. The third with 0.22%, fourth with 15.10% and fifth with 4.41%.

Interpretation of factorial designs for stations 1 and 2 (palm planting age dependence)

For graphs interpreting proximity between points and major plants and the role of each point in determining an axis by contributions examination, must be considered (Saporta and Bouroche, 1980). Also, the eigenvalues can be described as part of the information explained by the different axes. Elements that have the highest contributions are the most explanatory to the main axis considered. A representation of the projection of the stations in the factorial designs 1 and 2 is shown in Figure 5. The position of stations reflects the affinities and the correlations between various plantations ages. According to axes 1 and 2, there are five subdivisions of point clouds. The first is located on the positive part of axis 1 which is formed by the station P5. The second and third, meanwhile, are on the positive part of axis 2 which includes the stations P1 and P3. The fourth station is represented by station P10, which is localized on the negative part of axis 2 and the fifth is represented by station P7, which is in the negative part of axis 1. Thus, we see that there is an affinity between the stations P1 and P3 on the one hand, and stations P7 and P10 on the other. These stations (P7 and P10) show a very rich species and individual numbers. Stations P1 and P3 represent the first years of plantation where they show a low wealth of species and individual numbers.

Interpretation of the axes 1 and 2 species composition

According to axes 1 and 2, there are 8 groups:

Group 1: *Epilohmania aegyptica pallida*
Group 2: *Haplochthonius variabilis*
Group 3: *Oppia neerlandica*

These three species are confined much more in the stations P7 and P10 station

Group 4: *Scheloribates* sp.
Group 5: *Phthiracarus nitens*

These two species are much more confined to P1 and P5 stations

Group 6: *Oppia bicarinata*

This species is common to all stations

Group 7: *Galumna* sp.
Group 8: *Paleacarus* sp.

These last two species mark their presence, especially at stations P5 and P7 station.

DISCUSSION

The present study was conducted in a palm groves ecosystem that was used to identify eight species of oribatid inhabiting palm plantations, whose ages were 7 and 10 years. There were 6 and 7 species in palms of 1 and 3 years, and 3 species in palms of 5 years. The number of species range from 0 in control, up to 125 individuals in P3 station (5 year palms). *Scheloribates* sp., with a total of 450 individuals, seems to be the most dominant species in all palm stations. This wealth, even if it is real low compared to other environments, including the Northern regions where ecological conditions are significantly better (Davet, 1996; Fekkoum, 2010) constitutes a very interesting index. Indeed, this wealth can show that oasis ecosystems in relation to the surrounding areas, offer a different biotope, where ecological conditions are much better. Lincoln et al. (1982) noted that the species, communities, or organizations can provide clues; and the presence or absence of certain species, provide information on the environmental quality. Indeed, the presences of oribatid species in these environments show a significant change in these groves, in particular point of view, the microclimate and nutritional support.

Thiele (1977) stressed that the distribution and activity of arthropods, are largely determined by climatic factors; such as temperature and humidity, as well as nutritional substrate (Travé, 1963). The control site, where no species were found, shows that the Saharan environment is an unfavorable environment for the development of mites. This is partly due to prevailing climatic factors and land degradation, which is characterized by the complete

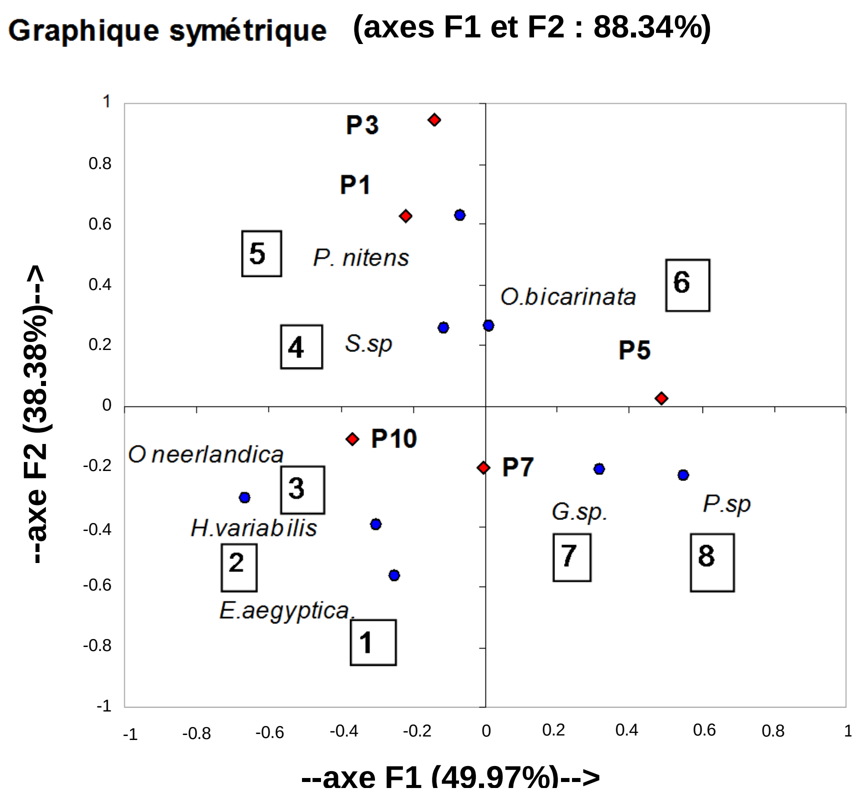

Figure 5. Factorial analysis of correspondence.

absence of plant cover that determine, to a large extent, the presence of oribatids.

The amendments and irrigation, and the microclimate created by palm trees create the requirements of mites that makes the environment more favorable. Tousignat and Coderre (1992) showed that species abundance and community structure of arthropods depend usually on biotic and abiotic factors of the environment. Also, Athias and Cancela (1976) showed that rainfall remains an important factor for soil fauna. Nef (1971) showed that moisture is also prominent as the temperature; it profoundly influences the soil fauna by adjusting the intensity, location, and activity of individuals involved in the numerical changes of microfauna. Furthermore, Temperature can induce a change in the community structure of Oribatid towards this factor (Webb et al., 1998; Gergocs and Hufnagel, 2009). The richness and complexity of communities trace the historical and biogeographical events of the medium and bio-ecological factors available (Lincoln et al.,1982).

These communities show intra-and interspecific relationships, on one hand, and their relationship with the environment, on the other. However, they can learn about the integrity or degree of impairment of the environment, thus constituting a basis for studies of ecosystems and their evolution. According to the presence of soil organisms, particularly acarofaune, depends directly on the nutritional substrate (Travé, 1963). It was noted that Oribatid group had fundamental characteristics that can indicate the different environmental changes (Gergocs and Hufnagel, 2009). These characteristics are widely mentioned (Lebrun and Van Straalen, 1995; Behan, 1999; Gulvik, 2007). According to these authors, Oribatid behavior can be used to indicate human impact effects in an environment. This phenomenon of human impact has always a harmful effect on the environment.

We can say that this implementation of the oasis ecosystem, even as the work of man, has to change the landscape typical of the Saharan, by creating a particular habitat. While the objective of this change was a matter of survival for indigenous people, the combined effort of all generations throughout the ages has to create a microenvironment that, not only addressed the need of the population, creates an ecologically favorable environment for a variety of species that find it a suitable refuge. Indeed, the particular nature of date palm and climatic requirements, essential for growth should be noted; and the environment of the palm should be made a very special habitat (Benziouche et al., 2010).

Conclusion

This study on oribatid mites in the oasis ecosystem in Algeria, being the first, shows the effect of man's activities, where the negative effect on the environment can sometimes be useful. This can be generalized in the areas that have undergone degradation. But this can only be done through careful study and multidisciplinary research in order to create favorable habitats for all species of animals, and especially species that are actively involved in soil environments, to improve soil conditions by their action of biodegradation.

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