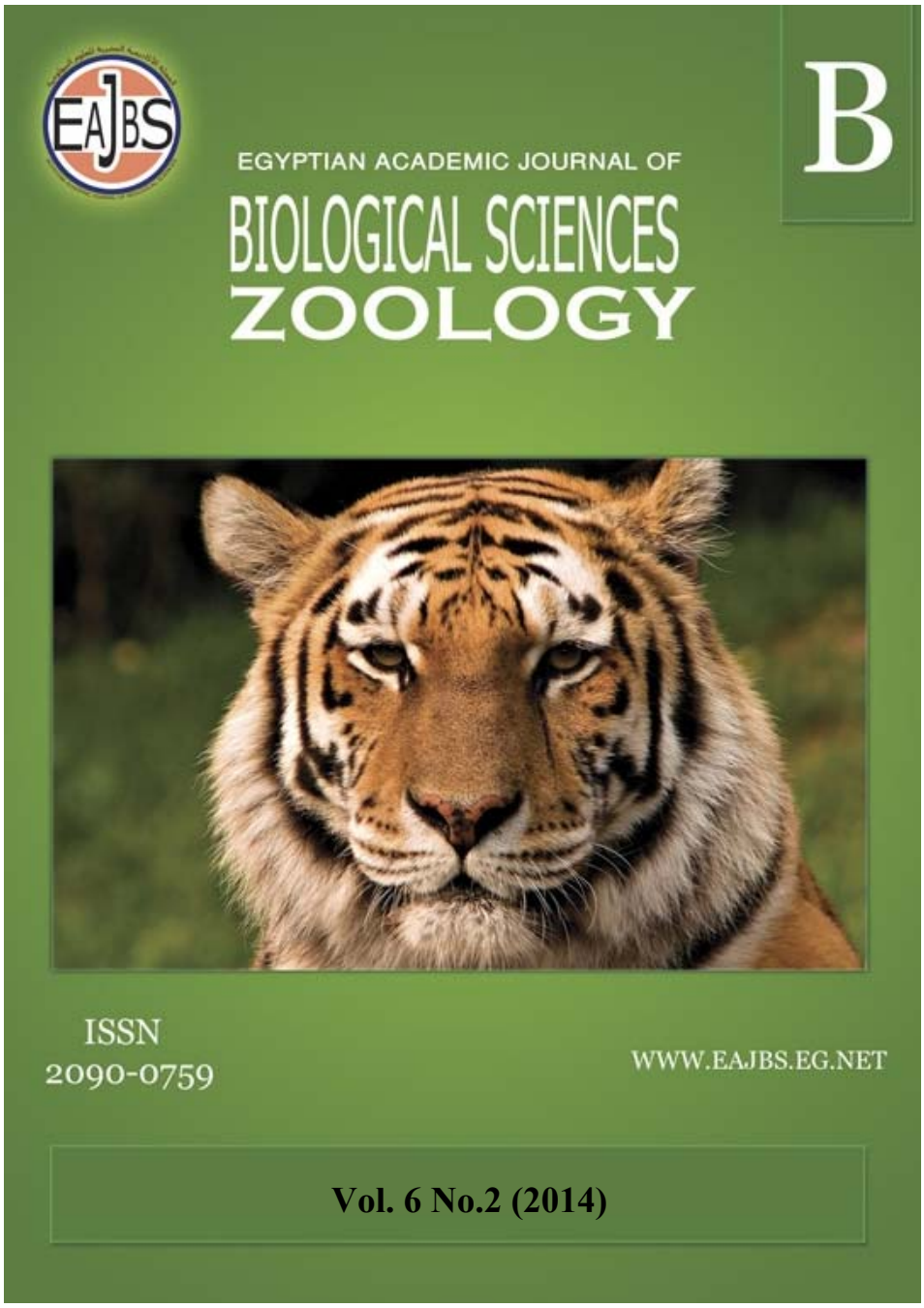

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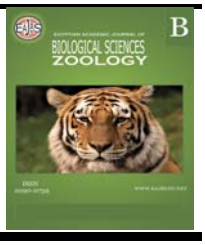

Abundance and Diversity of Mites Associated with Date Palm, Olive and Citrus Trees in Sakaka, Kingdom of Saudi Arabia

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ABSTRACT

Mites are part of important functional groups inhabiting arboreal parts of plants and soil food webs. Recognizing these mites and understanding their function in the ecosystem as well as when they are active is essential to understand their roles. The present work studied the abundance and diversity of mites associated with date palm, olive and citrus trees in Sakaka, Kingdom of Saudi Arabia during winter and spring seasons (December 2013 to May 2014).The recorded species associated with date palm, olive and citrus trees are classified according to the type of nutrition into three trophic groups: phytophagous, predaceous and miscellaneous mites. In total, 12 families, 13 genera and 13 mite species belonging to the four sub-orders Actinedida, Acaridida, Oribatida and Gamasida were recorded. The phytophagous mites were numerically dominant of three species belonging to two families. Whereas five species are predaceous mites belonging to five families. Moreover, the miscellaneous five species belonging to five families. Results obtained from this study revealed data about species recorded for the first time in Sakaka, Kingdom of Saudi Arabia where there is a need for such information to support future environmental programs in integrated pest management to attain good and healthy agricultural product.

Keywords: Saudi Arabia, Sakaka, identification, abundance, date palm, olive, citrus, phytophagous, predaceous and miscellaneous mites.

INTRODUCTION

The groundwork for essential taxonomic studies of agricultural mites is extremely rare in Kingdom of Saudi Arabia (KSA). Consequently, plant feeding and predatory mites have been poorly investigated in KSA resulting in insufficient information about the biology and ecology of these mites (Al-Shammery, 2009). Such information is highly required for successful integrated pest management (IPM) programs. Moreover, this information will help to improve the recently introduced programs to KSA such as organic farming and biological control programs (Fouly and Al-Rehiayani, 2011). A few numbers of phytophagous mite species have been previously reported on vegetable crops in KSA (Martin, 1972).The family Tetranychidae includes the most injurious plant-feeding mites (Meyer, 1987 and Zhang, 2003).The family Tenuipalpidae are usually considered to be secondary pests,

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but the ability of some species of the genus *Brevipalpus* to vector plant viruses has necessitated an updated review of this relatively little known family (Gerson, 2008).

Soil mites are abundant organisms that are sensitive to soil perturbations in agricultural practices and their number and diversity often get reduced affecting their ecosystem services (Minor and Cianciolo, 2007). Several genera of soil mites are considered good bio-indicators of habitat and soil conditions (Behan-Pelletier, 1999). The soil microflora and fauna complement each other in commutation of litter, mineralization of essential plant nutrients and conservation of these nutrients within the soil system (Marshall, 2000).

This study specifically pursued the following objectives:

(1) Conducting abundance and diversity of phytophagous, predaceous and miscellaneous mites associated with date palm, olive and citrus trees.
(2) Determining the distribution and abundance of these mites at different soil and litter of the date palm, olive and citrus trees.

MATERIAL AND METHODS

Extraction and preparation of mite specimens:

The samples were taken from soil at six locations in Sakaka, Kingdom of Saudi Arabia, monthly during winter and spring seasons (December 2013 to May 2014). The samples were taken from soil under date palm, olive and citrus trees orchard. Three soil samples were taken from (0-20 cm depth) by rectangle (6x6x8 inch), one Kg /sample, at each location, then were put singly in tightly closed polyethylene bags. In the laboratory, mites were extracted from soil samples using the Berlese-Tullgren funnel extractor (Lasebikan, 1974). Receiving the extraction (mites and other arthropods) in aquatic medium helped in purification and prohibit escaping mites. Extracted mites were then transferred to solution containing ethanol and acetic acid at 9: 1 ratio, sudden death solution, which quickly killed mites and stretched their bodies (Elmoghazy, 2002). After that, mites were transferred to clearing solution such as Nesbitt's solution or lactic acid for a period depending on mite species and inflexible degree. Mite individuals were picked from clearing solution and singly mounted in Hoyer’s medium on glass slides and sample data was recorded on each slide.

Sampling from fruit orchards trees:

The samples were collected from fruit orchards trees from the same ex-locations and times. Random samples of the leaves were picked from different trees that could be reached easily by hand then singly kept in tightly closed paper bags. Fifty leaves were randomly collected for each tree species, and then transferred to the laboratory for examination, using a stereomicroscope. A label including all necessary information concerning habitat, locality and date of collection was stuck on each bag. All stages of the mites were counted and recorded (except their eggs).

Mite identification:

All the mounted mites were examined under a compound microscope and identified to species level using appropriate taxonomic references as well as comparing them with those already identified in the Laboratory.

RESULTS AND DISCUSSION

Identification and abundance of mites:

Results presented in table (1) show the identification and abundance of mites inhabiting Sakaka, Kingdom of Saudi Arabia. From the obtained results, the collected

mites from leaves and soil were belonging to thirteen species. Based on the generally known of the primary feeding habits, mites were categorized into three trophic groups: phytophagous, predaceous and miscellaneous. The phytophagous mites were numerically dominant of three species belonging to two families [*Tetranychus urticae* Koch, *Oligonychus afrasiaticus* (McGregor) and *Brevipalpus obovatus* Donnadieu]. Whereas five species are predaceous mites belonging to five families [*Cunaxa* sp., *Apostigmaeus navicella* Grandjean, *Typhlodromips (Amblyseius) swirskii* Athias-Henriot, *Rodacarus* sp. and *Androlaelaps casalis* (Berlese)]. Moreover, the miscellaneous five species belonging to five families [*Iponemus* sp., *Tydeus oregonensis* Baker, *Tyrophagus longior* (Gervais), *Lohmannia* sp. and *Epilohmannia cylenderica* Berlese]. This is in agreement with Garcia *et al.* (1986) who surveyed phytophagous, saprophagous and predaceous mites associated with foliage of citrus trees in Spain. They recorded the Tetranychidae with three species, Tenuipalpidae with four species, Phytoseiidae with twelve species and Tydeidae with nine species. The date palm mite *Oligonychus afrasiaticus* (McGregor) is a serious pest of date palm fruits in Saudi Arabia (Talhouk, 1991). It was recorded to infest date fruits in orchards in Dirab, Unayzah and Al Sulayell districts and spreads in Hail, Qassim, Riyadh, Al-Kharg and Dammam regions (Al-Shammery, 2008). As regard predaceous mites, Chant & McMurtry (2007) and Beaulieu *et al*. (2011) recorded that family Phytoseiidae Berlese comprises over 90 genera and more than 2,300 nominal species in the world.

Table (1): Identification of mites associated with date palm, olive and citrus trees in Sakaka, Kingdom of Saudi Arabia.

Order: Acariformes		
I- Suborder: Actinedida		
Family	**Species**	**Trophic group**
1. Cunaxidae Thor	*Cunaxa* sp.	Predaceous
2. Stigmaeidae Oudemans	*Apostigmaeus navicella* Grandjean	Predaceous
3. Tetranychidae Donnadieu	*Tetranychus urticae* Koch	Phytophagous
	Oligonychus afrasiaticus (McGregor)	Phytophagous
4. Tenuipalpidae Berlese	*Brevipalpus obovatus* Donnadieu	Phytophagous
5. Tarsonemidae Kramer	*Iponemus* sp.	Miscellaneous
6. Tydeidae Kramer	*Tydeus oregonensis* Baker	Miscellaneous
II-Suborder: Acaridida		
1. Acaridae Leach	*Tyrophagus longior* (Gervais)	Miscellaneous
III-Suborder:Oribatida		
1. Lohmaniidae Berlese	*Lohmannia* sp.	Miscellaneous
2. Epilohmaniidae Oudemans	*Epilohmannia cylenderica* Berlese	Miscellaneous
Order: Parasitiformes		
Suborder: Gamasida		
1. Phytoseiidae Berlese	*Typhlodromips (Amblyseius) swirskii* Athias-Henriot	Predaceous
2. Rodacaridae Oudemans	*Rodacarus* sp.	Predaceous
3. Laelapidae Berlese	*Androlaelaps casalis* (Berlese)	Predaceous

Host plants and mite species:

Comparing the types of mite species that have been counted from the date palm, olive and citrus trees, both on the leaves or soil, it was observed that these types and numbers vary depending on the host plant, table (2) and figure (1). All trophic groups phytophagous, predaceous and miscellaneous of mites inhabiting the arboreal parts of date palm, olive and citrus trees. The mites were found on the leaves at flush growth. Phytophagous mites were highest number found on the leaves followed by the miscellaneous species. The population density of *Tetranychus urticae* Koch is higher than other mites. This is in agreement with Vacante (2010) who conducted a review of the phytophagous mites collected on citrus in the world and observed that the *T. urticae,* and *B. obovatus* had a worldwide distribution.

On the other hand, it was observed that the miscellaneous mites had highest number found in the soil followed by the predaceous species. Predaceous mites play an important role in suppressing pest population occupying different habitats and used in biological control programs (Amitai, 1992). This is in agreement with Elmoghazy & Shawer (2013) who said that the environment of soil organisms in managed ecosystems can be influenced by land use factors, such as tillage, pesticides and fertilizers application, soil compaction during harvest, and removal of plant biomass. The responses of soil communities to land management, quantified as changes in abundance, species richness and diversity indices, have generally been examined at habitat-wide scales Vreeken-Buijs *et al.,* (1998). Agricultural practices alter not only the abundance and dynamics of different organisms and nutrients in the soil, but also affect the structure and dynamics of the food webs (Moore, 1994).

Table (2): Comparison between host plants and recorded mite species with regard to occurrence and abundance in Sakaka, Kingdom of Saudi Arabia.

Mite Species	Host plant	Occurrence	Abundance
1. *Cunaxa* sp.	Olive, *Olea europea* L.	Soil	*
2. *Apostigmaeus navicella* Grandjean	Citrus, *Citrus* spp.	Soil	*
3. *Tetranychus urticae* Koch	Date palm, *Phoenix dactylifera* L.	Leaves	**
	Citrus, *Citrus* spp.	Leaves	***
4. *Oligonychus afrasiaticus* (McGregor)	Date palm, *Phoenix dactylifera* L.	Leaves	**
5. *Brevipalpus obovatus* Donnadieu	Olive, *Olea europea* L.	Leaves	**
6. *Iponemus* sp.	Citrus, *Citrus* spp.	Soil	**
7. *Tydeus oregonensis* Baker	Citrus, *Citrus* spp.	Leaves	**
8. *Tyrophagus longior* (Gervais)	Date palm, *Phoenix dactylifera* L.	Soil	**
9. *Lohmannia* sp.	Citrus, *Citrus* spp.	Soil	**
10. *Typhlodromips (Amblyseius) swirskii* Athias - Henriot	Citrus, *Citrus* spp.	Leaves	**
11. *Epilohmannia cylenderica* Berlese	Olive, *Olea europea* L.	Soil	**
12. *Rodacarus* sp.	Date palm, *Phoenix dactylifera* L.	Soil	**
13. *Androlaelaps casalis* (Berlese)	Citrus, *Citrus* spp.	Soil	**

* = (<4) mites/ leave or 0.5 kg. soil
** = (4 - 8) mites / leave or 0.5 kg. soil
*** = (>8)mites/ leave or 0.5 kg. soil

Figure (1): Host plants and number of mite species recorded in Sakaka, Kingdom of Saudi Arabia.

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ARABIC SUMMARY

تواجد وتنوع الأكاروسات المصاحبة لأشجار النخيل والزيتون والحمضيات في مدينة سكاكا بالمملكة العربية السعودية

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تقوم الأكاروسات التي تتواجد على المجموع الخضري للنبات وكذلك المتواجدة في التربة بدور هام في السلسلة الغذائية الطبيعية، ولذا فمن الضروري دراسة تلك الأكاروسات وفهم دورها في النظام البيئي. وفي هذه الدراسة يتم التعرف على تواجد وتنوع الأكاروسات المصاحبة لأشجار النخيل والزيتون والحمضيات في مدينة سكاكا بالمملكة العربية السعودية خلال موسمي الشتاء والربيع (من ديسمبر ٢٠١٣ إلى مايو ٢٠١٤). ولقد صنفت الأنواع التي تم تسجيلها على حسب تغذيتها إلى ثلاث مجموعات: الأكاروسات المتطفلة على النبات، والأكاروسات المفترسة، والأكاروسات متنوعة التغذية حيث تم تسجيل ١٣ نوعاً من الأكاروسات تحت ١٣ جنساً ينتمون إلى ١٢ فصيلة تندرج من أربع تحت رتب هي عديمة الثغر التنفسي، وذات الثغر التنفسي الأمامي، والحلم الخنفسى، وذات الثغر التنفسي المتوسط. ولقد لوحظ أن الأكاروسات المتطفلة على النباتات كانت الأكثر من ناحية الكثافة العددية للنوع الواحد؛ ولقد سُجل فيها ثلاثة أنواع مختلفة ينتمون إلى فصيلتين، بينما سُجل خمسة أنواع من الأكاروسات المفترسة تنتمي إلى خمس فصائل، وكذلك من الأكاروسات متنوعة التغذية سُجلت خمسة أنواع تنتمي إلى خمسة فصائل. وهذه الأنواع جميعها التي تم حصرها في هذه الدراسة تُسجل للمرة الأولى في مدينة سكاكا بالمملكة العربية السعودية، حيث هناك حاجة لمثل هذه المعلومات لدعم البرامج البيئية المستقبلية في مجال المكافحة المتكاملة للآفات للوصول إلى منتج زراعي جيد وصحي.