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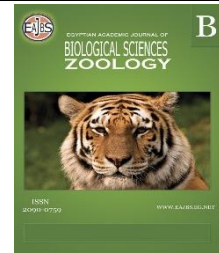


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Incidence and Diversity of Mite Species Associated with The Red Palm Weevil, *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae) at Beheira Governorate, Egypt

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ABSTRACT

Various species belonging to the genus *Rhynchophorus* are widely distributed, the red palm weevil (RPW), *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae), is a beetle species that relies on palm trees to complete its life cycle. The larvae of RPW feed on the trunk of the palm tree, which can lead to the tree's death, causing significant damage to both wild and cultivated palm trees in various countries. Invasive populations of the red palm weevil (RPW) have caused significant economic and biodiversity losses, leading to its classification as a major pest. It infests various palm species in Egypt and has been designated by the FAO of the United Nations as a "category-1" insect pest of date palms in the Middle East and Africa.

An incidence study for the mite families associated with *Rhynchophorus ferrugineus* adults, cocoon and their habitats in the core of palm tree was conducted at Beheira governorate, Egypt. To throw more lights on their roles as natural enemies for the Red Palm Weevil (RPW).

A total of 25 mite species belong to 13 families (Uropodidae Kramer, Macronyssidae Oud., Ascidae Oud., Ameroseiidae Evans, Digamasellidae Evans, Acarophenacide Cross, Sejidae Berlese, Pygmoformidae Cross, Scutacaridae Oud., Acaridae Ewing and Nesbitt, Histostomidae comb, Pyroglyphidae Cunliffe and Oppidae Granjeen) and four suborders (Gamasida, Actinedida, Acaridida and Oribatida) were found associated with the Red Palm Weevil (RPW).

INTRODUCTION

The date palm (*Phoenix dactylifera* L.) is one of the oldest cultivated fruit trees in the world and is extensively grown in arid and semi-arid regions (Chao and Krueger, 2007). It holds significant socioeconomic value due to its nutritional, health, environmental, and social benefits. However, date palms are highly susceptible to various insect pests, which can cause severe infestations and negatively impact the quality and yield of dates. Among these pests,

the red palm weevil (RPW) is the most destructive, relying on date palms as its primary host and resulting in considerable economic losses.

The RPW, (*Rhynchophorus ferrugineus*), a species belonging to the family (Coleoptera: Curculionidae) (Olivier, 1790), is an insect pest originally native to South and Southeast Asia. It was first observed in the Gulf region during the late 20th century, where it caused extensive damage to palm trees. Over time, this pest expanded its geographic range, causing significant impacts in other areas (Rugman-Jones *et al.*, 2013).

The red palm weevil (RPW), *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae), is considered the most destructive pest of palm trees worldwide. Tackling the extensive economic losses and biodiversity threats it poses has become a global priority. Gaining deeper insights into its biology and genetics is crucial for developing effective strategies to reduce its impact. (Manee *et al.*, 2023).

The RPW is considered one of the most significant pests of palm trees worldwide, including Egypt. It infests over 26 palm species across 16 genera and has been classified as a major pest on the A2 list by EPPO in 2008 (European and Mediterranean Plant Protection Organization).

The development of the red palm weevil was investigated by many authors (Al Suhaibani *et al.*, 2001; Salama and Abdel-Razek 2002; Kaakeh 2005; El-Mergawy, and Al-Ajlan 2011).

On the other hand, there are many mite species found associated with the Red Palm Weevil (RPW), in a varying degree of bio relationship between each of the associated, ecto-, endoparasitic, predaceous, phoretic and fungivorous mites (El-Sharabasy, 2010; Al-Deeb *et al.*, 2011; Hassan *et al.*, 2011; Al-Dhafar and Al-Qahtani, 2012; Dilipkumer *et al.*, 2015).

However, the information about the mite fauna and the relationship with (RPW) is still incomplete and needs more studies.

So, in this study, we report the incidence of some important mites associated with (RPW) at Beheira governorate in Egypt, and throw more light to the economically important species on RPW adults, cocoon and their habitats in the core of palm tree and the diversity of those mites through establishment of a list of mite suborders, families and species that are associated with the Red Palm Weevil (RPW) preapprehension to use them as natural enemies and potential control agents of (RPW).

MATERIALS AND METHODS

Incidence and Collecting of Mites:

Various life stages, including pupae and adults of (RPW), were gathered from their natural habitat within the core of infested palm tree *Phoenix dactylifera* trunks, at Beheira governorate, Egypt from three regions (Rashid, Edko, and Dalangat area). Adult and immature stages of (RPW), along with material from their habitats, were collected and transported to the laboratory in plastic containers for detailed examination.

The Following Method Was Used for Extraction:

From RPW: each insect was individually examined under a dissecting microscope. Mites were carefully extracted from various parts of the insect cadavers, including the spiracular plates, under the elytra, wing axillaries, antennal bases, coxal cavity, thorax, abdomen, and inner surfaces of the elytra, using a fine brush or needle. Additionally, cocoons were opened to inspect the surface of the pupae for the presence of mites.

From insect habitat: Each sample was carefully mixed, placed in a Petri dish, and examined under a stereo microscope.

The collected adult mites and the different stages were recorded and cleared by using Nesbitt's fluid (chloral hydrate 40-gram, distilled water 25cc. and concentrated hydrochloric acid 25cc.), then mounted on glass slides using Hoyer's medium (distilled water 50 mg), gum

– Arabic (crystals) 30-gram, chloral hydrate 200 gram and glycerin 20 gram) and heated gently to stretch the mites and rendering them clear and transparent; labels including the necessary information were stuck to the slides.

Terminologies of identification was followed according to Lindquist and Evans (1965), Summers and Price (1970), Balogh (1976), Hughes (1976), Krantz (1978), Evans and Till (1979), Zaher (1984), Zaher (1986).

RESULTS AND DISCUSSION

In the course of the present investigation, an intensive incidence and diversity of the mites associated with the Red Palm Weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) were conducted at Beheira governorate in Egypt. A total of 25 mite species belong to 13 families, under four suborders were isolated from *Rhynchophorus ferrugineus* adults, cocoon and the core of palm tree.

Table (1), proves that two orders of mites, Parasitiformes including suborder Gamasida (Mesostigmata) and order Acariformes including three suborders Actinedida (Prostigmata), Acaridida (Astigmata) and Oribatida (Cryptostigmata) were collected as mites associated with the Red Palm Weevil (RPW) adults, cocoon and the core of palm tree.

Suborder Gamasida was represented by seven families as, Uropodidae Kramer, Macronyssidae Oud., Ascidae Oud., Ameroseiidae Evans, Digamasellidae Evans, Acarophenacidae Cross and Sejidae Berlese.

Suborder Actinedida was represented by two families as, Pygmephoridae Cross and Scutacaridae Oud. Then suborder Acaridida was represented by three families as Acaridae Ewing and Nesbitt, Histostomidae comb. And Pyroglyphidae Cunliffe, while suborder Oribatida was represented by one family Oppidae Granjeen.

Table 1: Incidence of some mites (mite order, suborder and family) associated with the Red Palm Weevil (RPW), *Rhynchophorus ferrugineus* (Olivier).

Order	Suborder	Family
Parasitiformes	Gamasida	Uropodidae Kramer
		Macronyssidae Oud.
		Ascidae Oud.
		Ameroseiidae Evans
		Digamasellidae Evans
		Acarophenacidae Cross
		Sejidae Berlese
Acariformes	Actinedida	Pygmephoridae Cross
		Pygmoforidae Cross
	Acaridida	Acaridae Ewing and Nesbitt
		Histostomidae comb.
		Pyroglyphidae Cunliffe
	Oribatida	Oppidae Granjeen

In this present incidence, seven families of mesostigamid mites were recorded in association with the Red Palm Weevil (RPW) adults, cocoon and the core of palm tree, including, family Uropodidae Kramer which was represented by three species belong to three genera as *Uroobovella marginata* Berlese, *Rhynchopolus rhynchophori* Oliver and

Trichouropoda patavina (Canestrini), which were found associated with larvae, pupae, and adults in high numbers and in the core of palm tree in a few number as shown in (Table 2).

Table 2: Mite species associated with the red palm weevil, *Rhynchophorus ferrugineus* at Beheira governorate, Egypt and their habitats.

Family	Mite species	Habitat		
		Adult	Pupa	Core of palm
Sub order: Gamasida				
Uropodidae Kramer	<i>Uroobovella marginata</i> Berles	*	*	*
	<i>Rhynchopolus rhynchophori</i> Oliver	*	*	*
	<i>Trichouropoda patavina</i> (Canestrini)	*	*	*
Macronyssidae Oud.	<i>Macronyssus</i> sp.	-	*	*
Ascidae Oud.	<i>Gamasellodes bicolor</i> (Berlese)	*	*	*
	<i>Proctolaelaps aegyptiaca</i> Nasr	-	*	*
Ameroseiidae Evans	<i>Ameroseius</i> sp.	-	-	*
Digamasellidae Evans	<i>Dendrolaelaps zaheri</i> Metwally and Mersal	*	*	*
Sejidae Berlese	<i>Sejus paloghi</i> Hirschmann	*	*	-
Sub order: Actinedida				
Acarophenacidae Cross	<i>Acarophenax meropsi</i> Rakha and Kandeel	-	*	*
	<i>Acarophenax</i> sp.	-	*	*
Pygmephoridae Cross	<i>Cerratoma szekessyi</i> Mahunka	*	*	*
Pyemotidae Oudemans	<i>Pyemotes herfsi</i> Oud.	-	*	*
	<i>Pyemotes</i> sp.	-	*	*
Scutacaridae Oud.	<i>Scutacarus evansi</i> Soliman & Kandil	-	-	*
	<i>Scutacarus</i> sp.	-	-	*
Sub order: Acaridida				
Acaridae Ewing and Nesbitt	<i>Caloglyphus rhizoglyphoides</i> (Zacvatkin)	*	*	*
	<i>Caloglyphus mycophagus</i> (Megnin)	*	*	*
	<i>Caloglyphus Berlese</i> (Michael)	*	*	*
	<i>Caloglyphus</i> sp.	*	*	*
	<i>Thyreophagus entomophagus</i> (Laboulbene)	*	*	*
	<i>Thyreophagus brevicrinacus</i> Robertson	*	*	*
Pyroglyphidae Cunliffe	<i>Austroglyphus geniculatus</i> (Vitzthum)	-	*	*
Histostomidae comb.	<i>Histosoma</i> sp.	-	*	*
Sub order: Oribatida				
Oppidae Granjeen	<i>Oppia bayoumi</i> Shreef & Zaher	-	*	*
Oribatulidae Thor	<i>Zygoribatulo tameyai</i> El-Badry and Nasr	-	*	*

These species are parasites on different immature stages of *Rhynchophorus ferrugineus* (Olivier) and had the ability to repress population density of RPW stages within few days by sucking the fluid in eggs, larvae, pupae (cocoon) and under elytra of adults (Al-Dhafar and Al-Qahtani 2012). Data in Table 2, also declare that the family mite

Macronyssidae Oud. was represented by one species belongs to genus *Macronyssus* as *Macronyssus* sp. which was collected as a parasite on pupae and also isolated from inside the core of the infested date palm trees.

Family Ascidae Oud. are known as phoretic on adult insects or as predator mites for eggs and larvae of some insects (El-kady *et al.* 2017) is represented too. Members of family Ameroseiidae Evans Residing in debris, organic manure, and insect nests, they primarily feed on fungi, only one species *Macronyssus* sp. belong to genus *Macronyssus* was collected from pupae and core of the palm trees.

Family Digamasellidae Evans was represented by one predatory mite species as *Dendrolaelaps zaheri* Metwally and Mersal, which were found associated with different stages of the red palm weevil.

Declarations:

Ethical Approval: This study has been granted by the Research Ethics Committee of Faculty of Agriculture at Al Azhar University in accordance with Egyptian laws and university.

Author's Contributions: The authors have equal distributions.

Competing interests: The authors declare there are no conflicts of interest regarding the publication of this article.

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