Hyperphoresy of Phoretic Deutonymph of *Aegyptus rhynchophorus* (Elbishlawi and Allam), (Acari: Uropodina: Trachyuropodidae) with the Red Palm Weevil *Rhynchophorus ferrugineus* (Oliver), (Coleoptera: Curculionidae) in Egypt

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ABSTRACT

Identified uropodid mite deutonymphs have been attached by anal pedicels to different places of adult red palm weevil.The behaviour of hyperphorsey of phoretic dutonymph was observed. The synchronization between dutonymph of *Agyptus rhyncophorus* (Elbishlawi and Allam) and the life cycle of RPW were studied. Anal glands were examined and photographed by using light and scanning electron microscope, The structure of dutonymph and factors affecting attaching were determined.

Key Words: Acari, Trachyuropodidae, Uropodid mite, Red palm weevil, Curculionidae, Anal gland, Hyperphorsey, Anal pedical, Phoretic dutonymph.

INTRODUCTION

Members of several mite families attack Coleoptera insects. The phoretic mites which hitch aride on a more mobile animal to get from one place to another. This behavior is known as phoresy and in other word is a commensalism rather than parasitism. But the dense accumulation of these mites may weight down their insect carriers causing reduction to their fitness and sometimes death (Ferry and Gomez 2002).

Hyperphoresy is a rarely observed phenomenon, in which an animal being phoretically transported carries another phoretic animal. A recent study on hyperphoresy among Uropodina travelling on coprophilous beetles, showed that the phenomenon is rather infrequent and its probability increases with increasing deutonymph density on beetles (Athias-Binche ,1994). In Uropodina, all deutonymphs can be phoretic in some species, e.g. *Uropoda orbicularis* (Müller, 1776); while others, e.g. *Uroobovella marginata* (Koch, 1839), both normal and phoretic deutonymphs are noted. A phoretic deutonymph has its anal region enlarged, and it is covered by a single, disc-like plate, bearing setae. A normal nymph is smaller and has two anal plates without setae (Evans,1992). In the case of mites of suborder Uropodina, the deutonymph is the phoretic stage. However,in some species all deutonymphs are phoretic, whereas in others phoretics only develop in certain habitats. The morphological adaptation to phoresy in the uropodid mites is the anal pedicel, which enables them to attach themselves to the cuticle of arthropods, especially insects. This is also true that the insects carry the deutonymphs. *U. orbicularis* is a wide spread European species (Błoszyk *et. al.*, 2002b). Elbishlawi and Allam (2007) reported that some fauna such as mites of *Fascuoropoda marginata* (koch) and *Agyptus rhynchophorus* **(**Elbishlawi and Allam**)** were found associated with pupae and adults of the red palm weevil *R. ferrugineus* inside the palm tree. The uropodid mite *A. rhynchophorus* has a phoretic relationship with the adult of the red palm weevil and can be transferred to the insect pupae from the adult. It was also associated with the larvae of the weevil. The adult mite was found on the thorax, the tergites of abdomen and inner elytera. This study, dealt with behavior of phoretic duotonymph of *A. rhynchophorus* the structure of anal pedicel and anal gland, proper place are preferable for attachment on adult red palm weevil and all were photographed with SEM and light microscope.

MATERIALS AND METHODS

Collect red palm weevil:

Last instar larvae, pupae and adults of *Rhynchophorus ferrugineus* were collected, using a hatchet, from the trunk of the infested palm trees in Ismailia governorate, Egypt during spring, summer and fall of 2009 and 2010. Adults and immatures of *R. ferruginus* were kept at 26±2C, 60-70% R.H. and 14 h. photoperiod. Samples of red palm weevil were placed in plastic boxes (20×10×10 cm) containing shredded sugar cane stem.

Extraction of mite:

The red palm weevills were carefully examined individually using the dissecting microscope. The detected mites were then removed gently with a fine brush or needle from different parts of the insect cadavers via spiracular plates, under elytra, wing

axillaries, antennal bases, coxacal cavity, thorax region, abdomen and inner elytera as well as pupae cocoons surface.

SEM study:

Live specimens were cleaned in several baths of distilled water to remove the debris, then briefly submerged in distilled water near boiling point in order to force extension of appendages. Specimens were then fixed in 3.5% concentration of glutaraldhyde for 6 hours, dehydrated in ethyl alcohol, dried using the critical point procedure,individually affixed to stubs using double-sided sticky tape,and sputter coated with gold-palladium (Fashing *et.al*, 2000). Microscopy was performed with a JEOL GM 4200 microscope.

Scanning electron micrographs of the mites and their attachments were conducted. The dorsal plate was taken off and internal viscera were photographed.

RESULTS AND DISCUSSION

Structure of anal region in phoretic form dutonymph of *Agyptus ryhncophorus* (Fig.1):

Phoretic deutonymphs with anal region enlarged , covered with a pair of disc- like plates, with one pair of adanal setae and one pair of ventral setae (Allam and El-Beshlawi, 2010) These results disagreed with Evans ,**(**1992) who reported that the phoretic deutonymph with anal region enlarged and covered by a single, disc-like plate , bearing setae. He also described the normal nymph to be smaller than the phoretic deutonymph and with two anal plates without setae.

Secriation of anal pedical and anal gland (Figs. 1 & 2):

Phoretic deutonymph has an anal gland which produces an anal pedicel from its secreation. The anal gland opens into the hind gut. The secretion hardens when it comes in contact with air forming a stalk that enables the deutonymph to be attached to the RPW. Once arriving on the carriers body, the deutonymph runs seeking for a proper place for attachment, then the mite presses and rubs its anus against the surface. During this process,the deutonymph gradually straightens its legs and raises its opithosoma, to allow the anal pedicel o extend. Thereafter, the legs are folded into the special cavities situated on its abdominal surface and transported to a new place. Figs. 1 and 2 show the dissected deutonymph and the anal gland as T shape (fig. 2). The anal pedicel has a selender spread with adeverse mushroom shape at its tip. This behaviour is necessary for secretion the special substance creating the anal pedicel.

Factors affecting attachment place and syncronization between phoretic dutonymph and stages of the red palm weevil (Fig. 3).

The synchronization between life cycle of *A. rhyncophorus* and life cycle of RPW showed that phoretic deutonymph of *A. rhyncophorus* was found on pupa as parasite and on adult as hyperphorsey(Fig. 3). Deutonymphs were found on inner elytra, trocanter of legs, Duetonymphs were not found singly but always a lot of numbers in clusters around the legs and inner elytra (Fig.3) during dispersal with adult of RPW. This behaviour showed the parasitism relation between *A. rhyncophorus and* RPW pupae. Deutonymph does not feed during hyperphorsey with adult of RPW. This result agreed with Turk and Turk (1957), Treat (1969) and Norton (1980) who reported that deutonymphs of *Uropoda orbicularis* were on the first and third pairs of legs of the beetle and the choice of the site by mites was not accidental. The most preferable places are those exposed to the lowest risk of brushing by the host .This result agreed with that of Ferry and Gomez (2002) who reported that the relationship of predatism and parasitism with different stages of RPW played an important role in the biological control of insect pests by suppressing their population. Certain predatory and parasitic mites are well known to be capable of regulation. Members of several uropodid mites attack coleopterous insects. These results agreed with those of Faasch(1967), who reported that some uropodid species show additional behaviour during the process of attachment.The deutonymph of *Uroobovella marginata* Kock during the moment after creation of the pedicel runs on the surface before detachment the carrier,to prolong the pedicel. Once reaching a new habitat, a phoretic deutonymph recognizes conditions. If they are appropriate for its further development, it detaches itself from the carrier. The behaviour of disconnection depends on the humidity of the substrate if the humidity is low, the pedicel became less elastic, which causes detachment. Furthermore, the deutonymph must be stimulated by specific olfactory stimuli. During disconnection, the mite leans forward and then stretches out its legs, standing on them. It lands again on the body of the carrier. runs forward and as a result of this behaviour the anal pedicel was detached from the anal area.Therefore, the deutonymph leaves the host and starts feeding in the new habitat and moults to both sexes. This result agrees with that of Athias-Binche

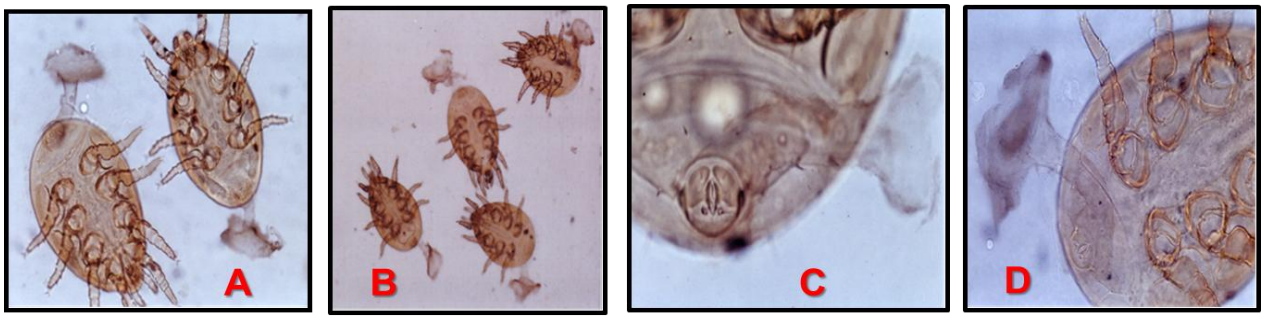

Fig. (1): Phoretic deuotonymph of *Agyptus rhyncophorus* secreted anal pedicels.
A- Mushroom shape of anal pedicl. B- Four dutonymphs taken from cluster from inner elytra.
C&D- Enlarged anal region with 2 anal plates and 2 pairs of setae.

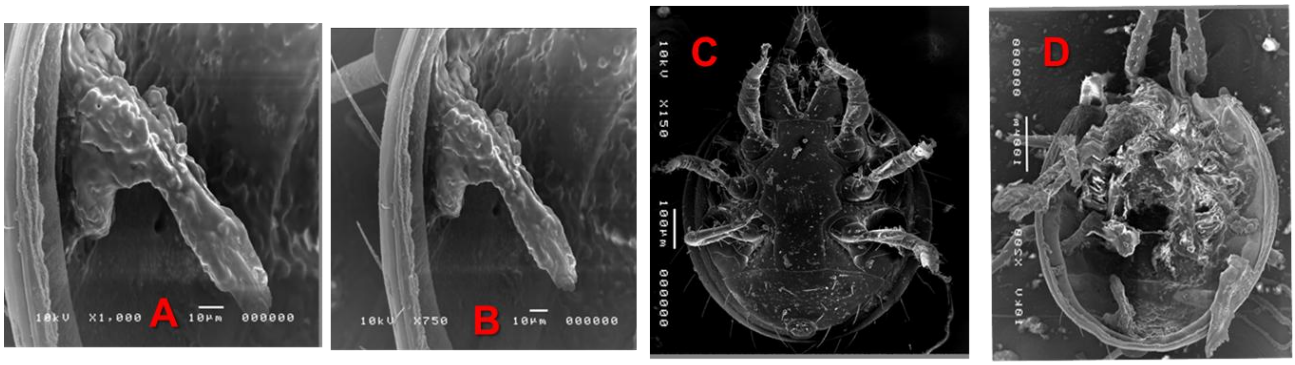

Fig. (2): SEM of anal gland of phoretic duotonymph. A- Anal gland. B- Anal gland secrieted anal pedical.
C- SEM of ventral duotonymph. D- SEM of inrternal viscera of phoretic duotonymph.

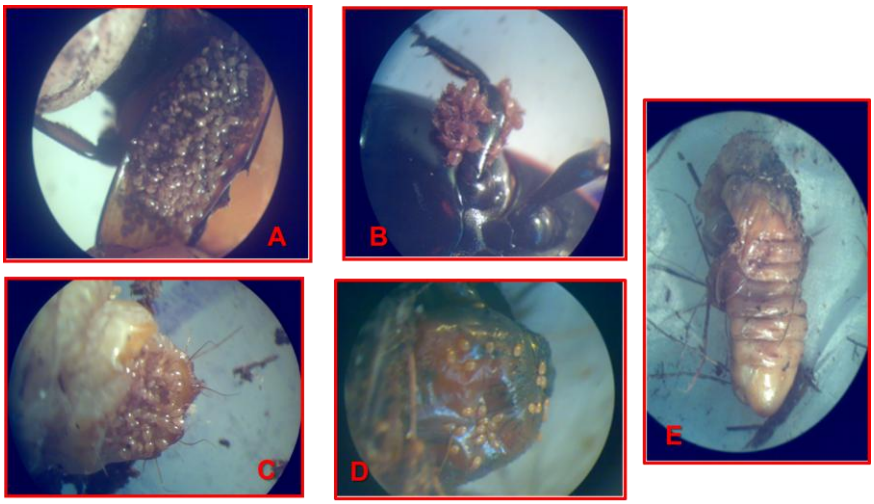

Fig. (3): Proper places for attachment of phoretic duotonymph *Agyptus rhyncophorus* on adult RPW and larvae in cluster. A- Cluster on inner elytra. B- Cluster on trochanter. C- Cluster on anal region of larvae.
D- Cluster on head of pupae of RPW. E- Mite on pupae of PRW.

(1993) who reported that the phoretic stage is usually either the last immature instar (the deutonymph) of both sexes, and or adult female.

Importance of hyperphorsy for dispersal (Fig .3):

Hyperphorsey is very important due to *A. rhynchophrus* for dispersal. RPW adults carry phoretic dutonymphs. It is important for dutonymph to reach pupae of RPW to develop to female. This result agrees with that of Athais - Binche (1994) who reported that hyperphoresy is a rarely observed phenomenon, in which an animal being phoretically transported carries another phoretic animal. A recent study on hyperphoresy among Uropodina travelling on coprophilous beetles, showed that the phenomenon is rather infrequent and its probability increases with increasing deutonymph density on beetles. .Also this agreed with that of Ferry and Gomez (2002) who reported that the phrotic mites which hitch aride on a more mobile animal for dispersal. The dense accumulation of these mites may weight down their insect carriers causing reduce of their fitness and sometimes causing death.

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