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Sensory system in the wings red palm weevil *Rhynchophorus ferrugineus*

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Abstract

Sensory receptors for the wings red palm weevil has been studies with scanning electron microscope. It was observed front wing (Elytra) for insect few hairs between contact wing with thorax basic, and campaniform organs, it is concentrate in wing insects that may be function mechanoreceptors. In general, cuticle for wing there are rough, it was groups from sheets superimposed over each other in some area from wing. The dorsal are transparent membrane very full of vines which extension from base wing until end it. Many kinds sensillae observed in dorsal wing (Membranous), these are: Trichoid, Basiconic, Trichoid bifed, Coeloconic, Styloconic. Also, we observed glandular pores on surface wings.

Keywords: Wings, *R.ferrugineus*, Sensillae, campaniform, Scanning electron microscopy.

Introduction

Date palm, *Phoenix dactylifera* 1. (Palmales: Palmae),is one of the oldest fruit trees in the world and is mentioned in the Qur'an and the Bible. There are approximately 100 million date palms worldwide, of which 62 million can be found in the Arab region. The origin of the date palm is uncertain. Some claim that the date palm first originated in Babel, Iraq, while others believe that it originated in Dareen or Hofuf, Saudi Arabia, or Harqan, an island on the Arabian Gulf in Bahrain. Known as the Asian palm weevil is one of the most destructive pests of coconut in South and Southeast Asia (Sadakathulla, 1991). The insect discovered in Saudi Arabia in the mid- 1980 (Gush, 1977; Abraham et al., 1998; Faleiro et al. 1999). Since then it has spread over most of the date palm areas (Bokhari and Abuzuhairah, 1992, Vidyasagar et al. 2000). One of the main causes of wounds is the detachment of offshoots from the mother tree.

Semiochemicals emanating from wounded or dying palms are attractive to *R.cruentatus* and *R.palmrum* adults. Female lay eggs in the leaf bases or directly into the wound of dying host palms, and immature stages develop in the crown and stem region where condition are moist (Rochat 1991, Weissling and Giblin 1993). Understanding of how the pest species sense the environmental changes could be of considerable importance in knowing how better to control them. Phytophagous insects are known to possess receptors sensitive to various host plant semiochemicals which act as phagostimulants to insects (Schoonhovev, 1972, Salama et al. 1984, Sharaby et al. 2002). Identification of the sense receptors in insects has t received the attention of many researchers (Yin and Li 1980; Van Der pers, 1980; Chadha and Roome 1980; Mayer et al. 1981; Salama and Abdel Aziz, 2001; Sen and Mitchell, 2001, and Said et al. 2003). The present study deals with identifying, describing and defining the distribution of different receptors on the wings of the red palm weevil adults with scanning electron microscope (SEM).

Materials and Methods

1.The experimental insects

The adult red palm weevil were obtained from infested palm tree and reared under laboratory condition (26± 1º C and 70 ± 5 % RH).

2. Sample preparation Scanning electron microscopy

The wings remove from adult insect after killed in chloroform, separated between them, then put it in Glutraldehyde 5% for 24 hours, then put samples in serial concentration from acetone 50%, 70%, 80%, 90%, 100%, then dried in chamber of scanning electron- microscope, SEM (Jeol- JSM- 5600 LV in SEM) in the low vacuum mode.

Results

1. Description the wings

As the red palm weevil from the insects affiliate order Coleoptera, they are carrying a couple wings. The front wing are elytra, which appear as scanning electron microscope hard, strong, color brown, show on it groups from lines, do not use these wing in flying (Fig. 1). Surface cuticle rough, it was groups from sheets superimposed over each other (Fig. 2) This wing protection the back wings, they are carrying few sensillae which concentrate in wing link with thorax area (Fig. 3). Scanning electron microscope appear numerous from campaniform organs which find on elytra wing, also found many glandular pores (Fig.4). The cuticle is hard, overlapping sheets over each other. As the membranous wings are the back part that characterized numerous vines that distributed on surface it. The insect use these wings in flying (Fig. 5a,b), the surface cuticle lie elytra wings (Fig. 6), it is clear, thin, find on surface many from sensillae (Fig. 6).

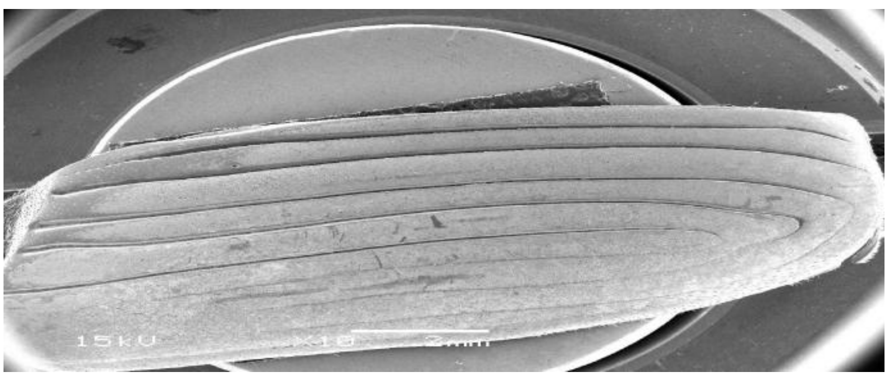

Figure 1: Scanning electron micrograph, showed dorsal view of elytra red palm weevil, *R.ferrugineus*

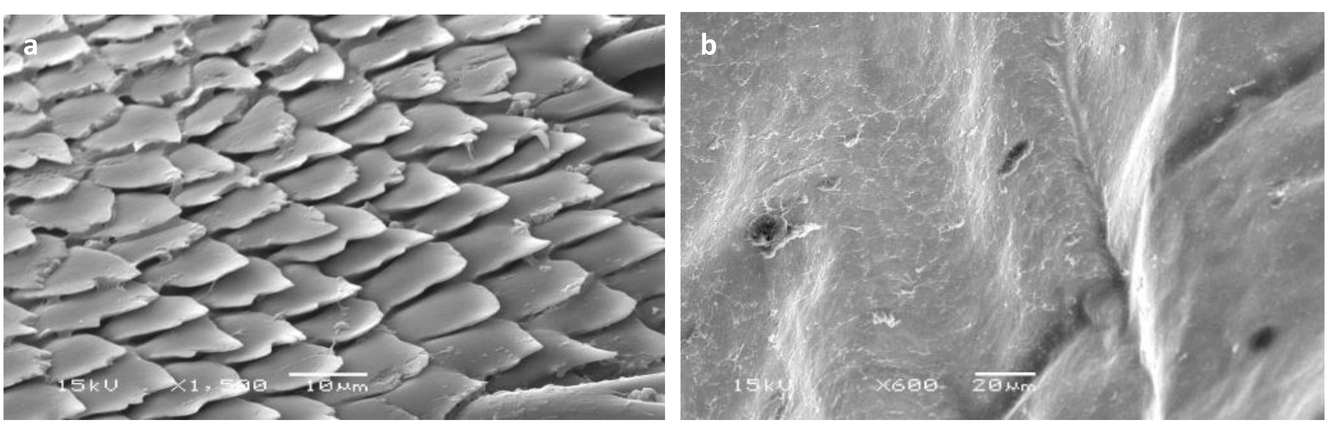

Figure 2:a: Surface of cuticle *R.ferrugineus*. b: glandular pores on surface wing.

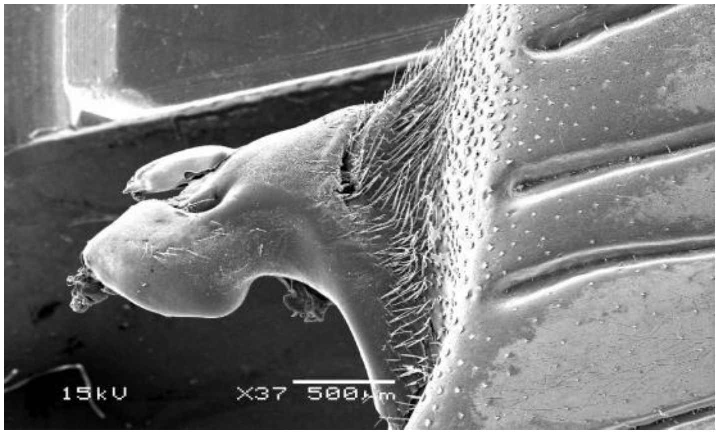

Figure 3: SEM showed area link of elytra with thorax, and numerous sensillae in these area.

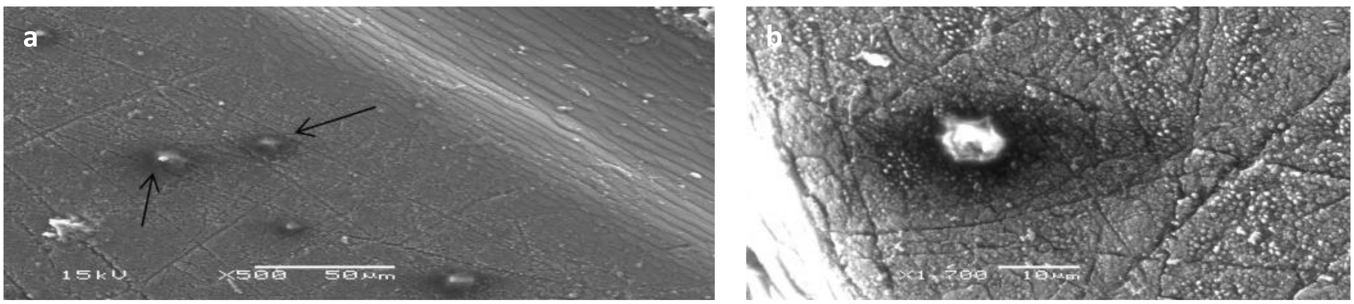

Figure 4: a: Campaniform organs on elytra. B: Magnification of cam. (arrow).

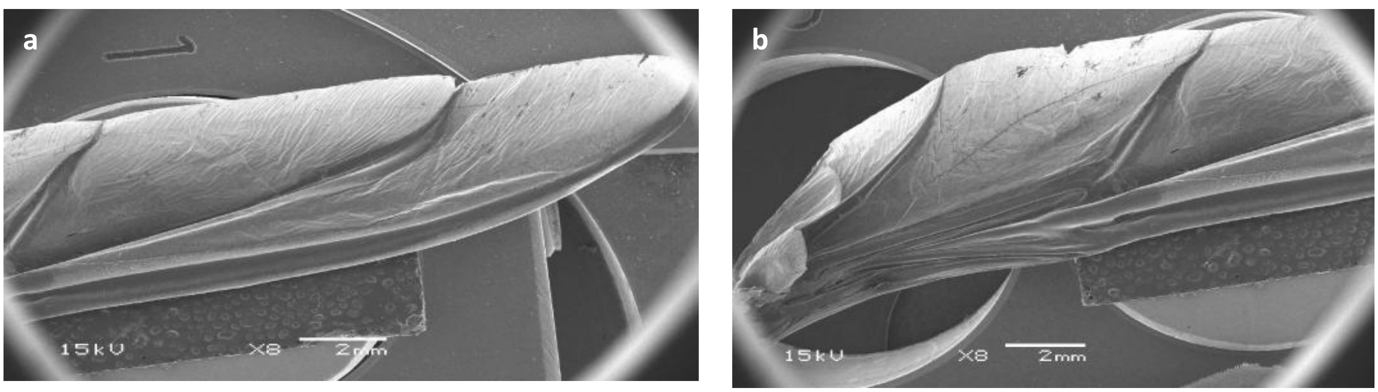

Figure 5: a: SEM showed membranous wing. b: Many vines on the membranous wing.

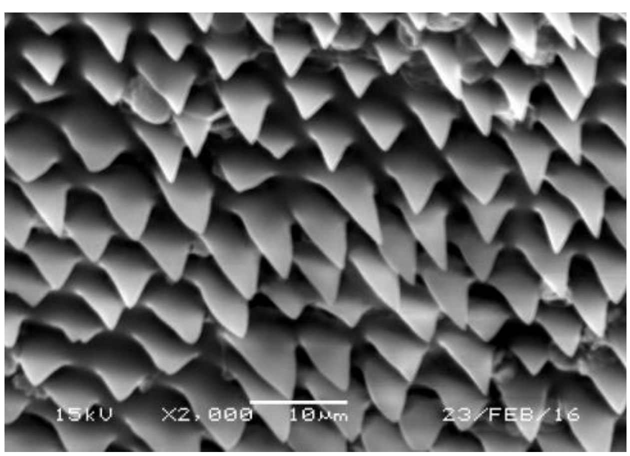

Figure 6: SEM of cuticle membranous wing.

Description sensillae

1. **Campaniform organs:** was observed on the elytra wing, it is recorded in previous study on the rostrum red palm weevil (Sharaby and Al Dosary, 2006). (Fig. 4).

2. **Styloconic**: These sensillae found dorsal wing, out side from base then extent to the end. It end tapered, multi porous on surface. on, wide basic, thick surface. These function may be olfaction (Fig 7).

3. **Coleoconic** : There are a great number of coeloconic sensillae distributed on all the dorsal surface of the membranous wing for both sexes(Fig 8). It is a circular pit in the cuticle with a central peg protruded from its center and surrounded by different number of trichoid sensillae at its circular edge.

4. **Basiconic**: Found between other sensillae. Short peg, multi porous, tick surface. (Fig. 9).

5. **Trichoid** : Long, multi porous, tapered edge. These function olfaction. (Fig. 10). Also, found trichoid bifid many kinds (Fig. 11). It is look like fingers, smooth wall, non pours.

6. **Infrared receptors (IR)**: Many investigators focused on mature stage to detect the role of infrared receptors (Fig.12). The IR receptors most likely have evolved from common contact mechanoreceptors.

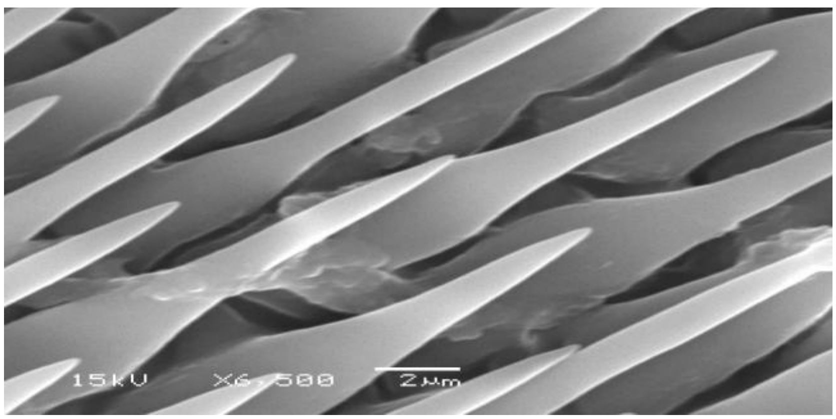

Figure 7: Styloconic sensilla.

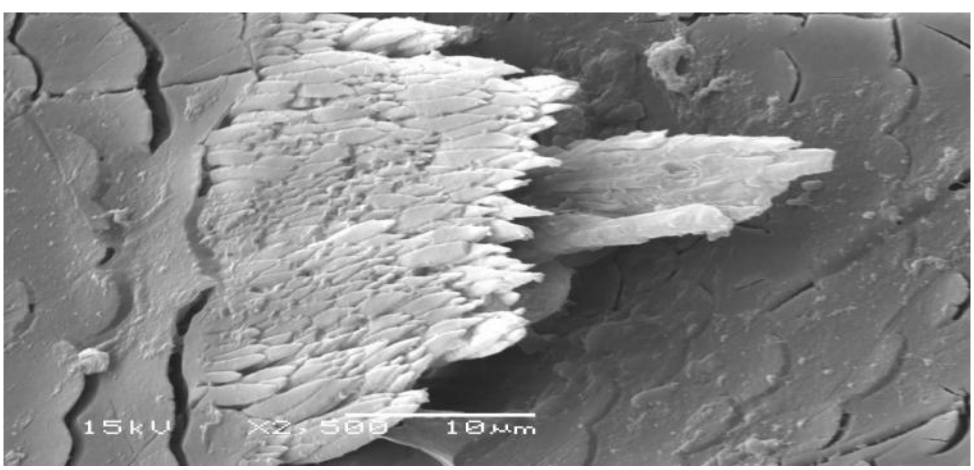

Figure 8: Coeloconic sensilla.

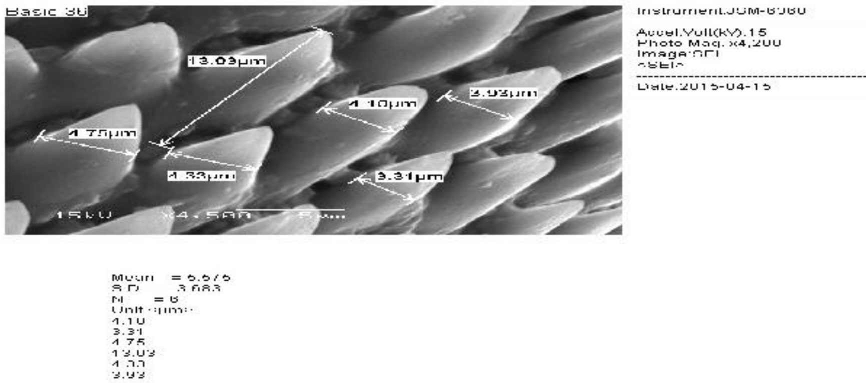

Figure 9: Basiconic sensilla.

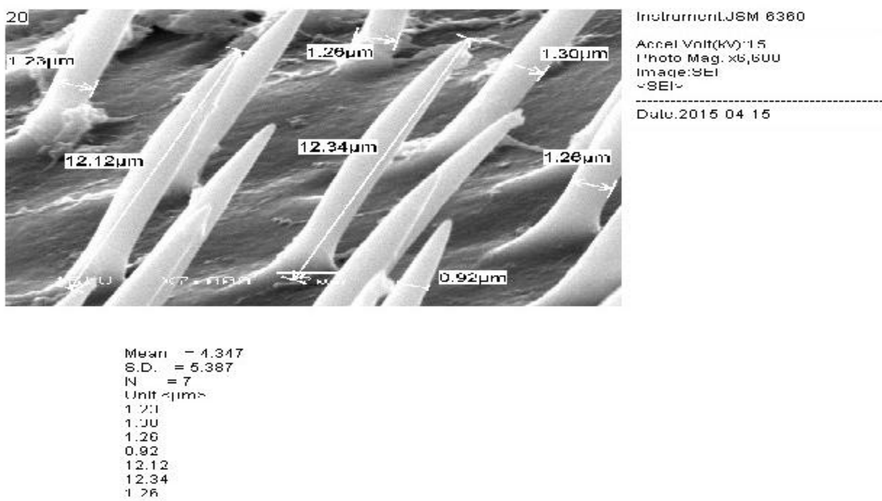

Figure 10: Trichoid sensilla.

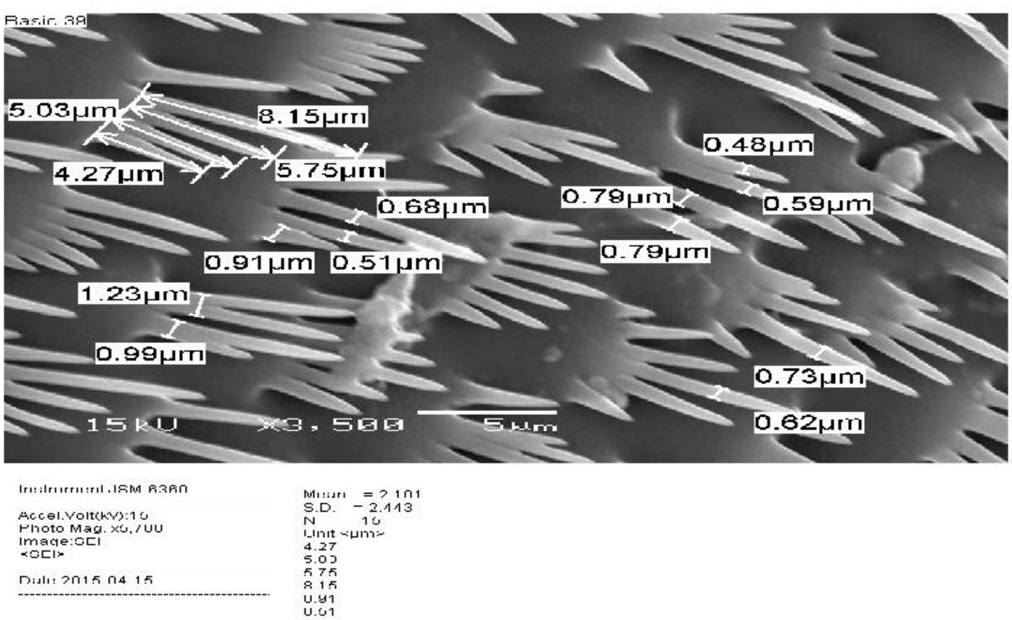

Figure 11: Bifid sensillae, many kinds on the wing like finger.

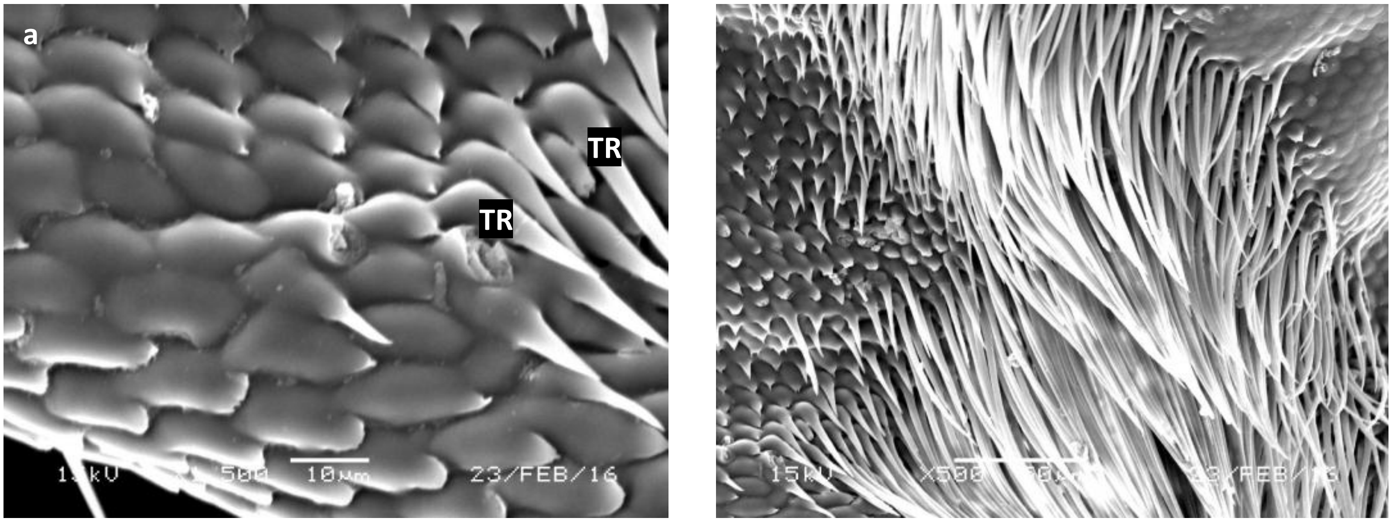

Figure 12: Infrared receptors in the cuticle wing red palm weevil. a: showed few IR-S. b: showed many IR

Discussion

In previous study (Sharaby and Al Dosary, 2006), it was recorded and description numerous from sensillae on different parts for red palm weevil, as described sensillae on mouth parts, head, antennae, legs, reproductive organs for male and female. Also, it has been studied sensillae on abdominal segments the same insects (Al Dosary, 2012). As in this study focused on sensory organs on wings red palm weevil, that noticed many form sensillae, it was the most important: campaniform organs play a role as sound and mechanoreceptors between the 9th and 10th segment of flagellum of *Conotrachlus nenuphar* as proprioception (Alm and Hall, 1986). Also Whitehead (1981) recorded campaniform organ on the antennae of female of *Dendroctonus ponderosae*. Mreive et al. (2003) mentioned this organ as temperature receptor in *Pterostichus aethiops* beetle; it is located at the terminal segment of the antennae of both males and females. It is possible that these disks have a secretory role, similar to that of glandular openings (Martin, 1977; Sutcliffer and Mitchell, 1980). Symondson and Williams (1997) found similar disk sensilla on the maxillary palps of *Pterostichus melanarius* with a raised orifice and on *P.niger* as a flat or sunken orifice, they are probable mechanoreceptors with a gustatory role. The same result of IR receptors was found by Ragaei and Al-Kazafy (2013). The authors found that these sensillae in wings, cuticle larvae and pupa red palm weevil. The larvae of red palm weevil may be used the IR sensilla to search the suitable food. The grubs cause damage inside the stem or crown by feeding on soft tissues and often cause severe damage especially when a large number of them bore into the soft growing parts. The IR receptor may be uptake IR radiation in a way not described in detail, the resulting thermal expansion of the cuticular sphere and gives the larvae energy needed for growth. Pupa may be using the IR receptors to get the thermal energy in its environments (Ragaei and Al-Kazafy, 2013). Mahmoud *et al*., (2012) found that many sensilla distributed on antenna of palm weevil adults. The adults of red palm weevil use these sensilla to get their food, oviposition and mating. In previous study (Al Dosary, 2007) on red palm weevil, observed the same trichoid and basiconic sensillae on antennae, this type hairs function is for gustation (Harbach and Larson, 1977) or for olfaction (Mustaparta, 1984).Bifid trichoid hairs different long, and base common to the two, three, four branches of the hair is thick but the branch extremities as much more frayed. Said et al., (2003) recorded this sensilla on antennal red palm weevil, the hair brunches arose in circular cuticle sections, either in contact or distant, according to the level of the cut. The observation revealed neither wall pores nor dendrites, but noticed a narrow central channel surrounded by electron dense areas, disposed in circle at the periphery of the hair. It is for protective function (Said et al., 2003) and did not seam to have sensory function similar to the non- innervated hair-like structure described in *Conotrachelus nenuphar* (Alm and Hall, 1986) and *Hylobius obietis* (Mustaparta, 1975).It is similar to that aforementioned described at the rostrum in previous study, Sharaby and Al Dosary (2006), it is a circular deep pit in the cuticle with a central peg protruded from the base pit. Numerous numbers of trichoid sensillae surround the circular rim of the pit arises an acuote angle from the cuticle, these sensilla homogeneuly together, it is in different length and thick ness. The mechanoreceptor and gustatory sensillae are the longest and the first to enter into contact with the substrate during antennation. They are probably involved in close range recognition of the host plant or the sexual partner. Probing of the substrate surface with antennae always occurs before feeding and egg-laying in *R.palmaram* (Said et al., 2003). Whereas the olfactory receptors for smoke are located on the antennae, the IR receptors are housed in extra-antennal sensory organs, which can be found on the thorax or on the abdomen (Klocke et al., 2011). Most insects have IR receptors in wings. In locusts, sensory afferents originating from the wing tegula (Braunig et al. 1983), from the wing-hinge stretch receptors (Altman and Tyrer, 1977), or from the wing itself (Braunig et al. 1983) terminate plurisegmentally, as do wing afferents in the beetle Tenebrio (Breidbach, 1990) and in winged ants (Gronenberg and Peeters, 1993).

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