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COCCOPHAGINAE PARASITOIDS (HYMENOPTERA: APHELINIDAE) WHICH ATTACKING ARMORED SCALE INSECTS (HOMOPTERA:DIASPIDIDAE) IN EGYPT

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ABSTRACT

The Coccophaginae parasitoids (Hymenoptera: Aphelinidae) can play a distinguished role in control of armored scale insects (Homoptera:Diaspididae) in Egypt. The present work deals with the survey of subfamily Coccophaginae and its role in controlling the armored scale insect in Egypt. Abundance of these parasitoids was carried out on 6 host plants attacking by 8 armored scale insects in 7 governorates . The results indicated that ten species of subfamily Coccophaginae attacking armored scale insects in Egypt. Thses are *Encarsia aurantii* (Howard), *Encarsia berlesei* (Howard), *Encarsia citrina* Craw, *Encarsia lounsburyi* Berlese & Paoli, *Pteroptrix aegyptica* Evans & Abd-Rabou ,*Coccobius* sp.,. *Coccophagoids kumanai* (Silvestri),. *Coccophagoids similies* (Masi), *Encarsia perniciosi* (Tower), *Pteroptrix bicolor* (Howard). The maximum parasitism rates of the first five species ranged from 17 - 35%. The rest of the species, the parasitism rates was rarely.

INTRODUCTION

Organophosphorus insecticides have been used commercially for the control of scale insects in Egypt for many years (Coll and Abd-Rabou,1998). Parasitoids of the armored scale insects (Homoptera:Diaspididae) found in Egypt play an important role in control of these insects that mainly exert a lot of damage to economic plant (El-Nahal *et al.*, 1980).

These parasitoids can play a distinguished role in control of seventy six species of scales that attack these economic plants and consequently reduce the evolution sound fruits. About 37 parasitoid species, according to new researches were compile collected, differentiated and classified by new means of classification and nomenclature (Abd-Rabou, 2003).

These will lead to rear and sometimes import the specific concerned parasitoids from abroad to combat these armored scale. In the mean time there are some other predators that attack and drastically reduce the number of armored scales. Family Aphelinidae is a moderate-sized family of tiny parasitic wasps, with some 1160 described species in some 35 genera. These minute insects are challenging to study as they deteriorate rapidly after death unless extreme care is taken (e.g., preservation in ethanol), making identification of most museum specimens difficult. The larvae of the majority are primary parasitoids on Hemiptera, though other hosts are attacked, and details of the life history can be variable (e.g., some attack eggs, some attack pupae, and others are hyperparasites) (Hayat, 1983). They are found throughout the world in virtually all habitats, and are extremely important as biological control agents. This family has six subfamily Aphelininae, Azotinae, Calesinae, Coccophaginae, Eretmocerinae, Eriaporinae. Subfamily Coccophaginae the most important parasitoids attacking armored scale insects and it has thirteen species (Hayat,1985). The present work deals with

the survey of subfamily Coccophaginae and its role in controlling the armored scale insects in Egypt.

MATERIAL AND METHODS

The specimens of aphelinids are best preserved as slide mounts. It may not be possible to see all the characters and measure some structures in carded specimens. However, when more specimens are available, it is preferable to have both slide mounted and carded specimens. Since body colour is likely to fade during clearing process, it might be necessary to note the colour and sculpture either from dried or freshly collected specimens preserved in alcohol. The smaller size of the specimens and their soft, less sclerotized bodies, make the specimens almost useless for study if preserved in alcohol for longer periods. The procedures of slide mounts after Abd-Rabou (1998) as follows: Dried specimens are soaked in glacial acetic acid (7 drops) mixed with chloral phenol (5 drops) in small watch glasses, after 48 hours specimens should be satisfactorily cleared, the cleared specimens are then mounted in Hoyer's medium and after drying for about two weeks under 40 °C, the slide cover is ringed with a suitable sealer. The terminology of the morphology of adult aphelinids used is mainly according to Hayat (1983).

Abundance of these parasitoids was carried out on 6 host plants [*Citrus* sp., *Cactus* sp., *Pyrus malus* (apple), *Olea* sp., *Mangefira indica*, *Conaspis* sp. and *Phoenix dactylifera*.) attacking by 8 armored scale insects (*Aonidiella aurantii* (Maskell) , *Quadraspidiotus* sp.,, *Parlatoria oleae* (Colvee), , *Pseudaulacaspis pentagona* (Targioni – Tozzetti), *Parlatoria ziziphi* (Lucas), *Insulaspis pallidula* (Green), *Parlatoria crotonis* Douglas, , *Parlatoria blanchardii* (Targioni-Tozzetti)) in ٦ governorates (El-Minya, Giza, Northern coast, Alexandria, Sharqyia, and North Sinai).

The selected plants for the present investigation did not received any chemical control for several years ago before this work. The samples from the host plant species were collected monthly from aforementioned locations during 2005-2006. For each host plant, the sample size was 30 leaves, with the exception of *Olea* sp., from which 80 leaves were collected in each sample. Each leaf was stored in a well-ventilated emergency glass tube and monitored daily for the emergence of the parasitoids.

Two methods were used to count the first and second nymphal instars, non gravid females, and the males (preadult) (scale stages) of armored scale insects and their parasitoids on the plant leaves as follows:

1. Square-inch method:

In this method, one square-inch was defined on the underside of each leaf and the armored scale insects and their parasitoids located in this area were counted and recorded. This technique was employed in the following plant species: *M. indica* , *P. dactylifera* and *Cactus* sp.

2. Whole leaf area method:

In this method, the scale found on the whole area of each leaf were counted and recorded. This method was employed in the case of *Citrus* sp., *Pyrus malus* (apple), *Olea* sp. and *Conaspis* sp. The parasitism percentage (Par.%) was calculated as follows:-

$$\text{Par. \%} = \frac{NP}{T} \times 100$$

Where NP = Number of parasitized individuals.
T = Total number of hosts.

RESULTS AND DISCUSSION

List of the species of subfamily Coccophaginae parasitoids attacking armored scale insects in Egypt

1. *Coccobius* sp.
2. *Coccophagoids kumanai* (Silvestri)
3. *Coccophagoids similies* (Masi)
4. *Encarsia aurantii* (Howard)
5. *Encarsia berlesei* (Howard)
6. *Encarsia citrina* Craw
7. *Encarsia lounsburyi* Berlese & Paoli
8. *Encarsia perniciosi* (Tower)
9. *Pteroptrix aegyptica* Evans & Abd-Rabou
10. *Pteroptrix bicolor* (Howard)

Key to the species of subfamily Coccophaginae parasitoids which attacking armored scale insects in Egypt (adopted from Abd-Rabou, 1999c)

1. **Tarsi 4-segmented, Antennae 7-segmented, tibial spur of fore leg curved.**
   2
   Tarsi 5-segmented.....4
2. **Submarginal vein with one seta, marginal fringe 0.7 times as long as wide .....*Pteroptrix aegyptica* Evans & Abd-Rabou**
3. **Submarginal vein with two setae, marginal fringe 0.4 times as long as wide .....*Pteroptrix bicolor* (Howard)**
4. **Antennae 7-segmented, if antennal formula 1,1,3,2; then either fore wing with linea calva or axillae very small, not projecting forewardsntennal formula 1,2,3,2; propodeum not distinctly longer than metanotum; mesoscutum with numerous setae; submarginal vein with 4 or more setae.....*Coccobius* sp.**
   Antenna 8-segmented; axillae small, apparently strongly projecting forward and separated mesally by more than the maximum length of an axilla; scutellum distinctly 1.5 times or more than as wide as long 5
5. **Submarginal vein with 3 or more setae, scutellum with 4-6 seta.....6**
   .Submarginal vein with 2 or rarely 1 seta, scutellum with 4 setae.....7

6. **First funicle segment ½ as long as second funicle segment .....*Coccophagoids kumanai* (Silvestri)**
   First funicle segment 2/3 as long as second funicle segment .....*Coccophagoids similies* (Masi)
7. **Stigmal vein of fore wing with an evident asetose area proximally.....8**
   Stigmal vein of fore wing without an evident asetose area proximally. At least one small seta proximal to the stigmal vein 9
8. **Submarginal vein of fore wing with 1 seta ....*Encarsia lounsburyi* Berlese & Paoli**
   Submarginal vein of fore wing with 2 seta (Fig. 42) .....*Encarsia citrina* Craw
9. **Ovipositor very short, clearly much shorter than mid tibia .....*Encarsia aurantii* (Howard)**
   Ovipositor as long as or slightly longer than mid tibia 10
10. **F3 less than twice as long as F2..... *Encarsia berlesei* (Howard)**
    F3 slightly longer than F2..... *Encarsia perniciosi* (Tower)

1. *Coccobius* sp.

Diagnosis : As shown in Fig.1,a), Antenna 7-segmented, the funicle with 3 segments, the club 2-segmented; mandible with 2 teeth and a truncation; maxillary palpi 2-segmented, the labial palpi unsegmented. Mid lobe of mesoscutum with numerous setae, each axilla with a single setae and usually with 4-6 setae. Ovipositor usually not protruding strongly at gastral apex.

Material Examined: 20 ♀♀, El-Minya, VI.2006 ex. *A. aurantii* on *Citrus* sp.

Distribution: El-Minya governorate.

Hosts: *A. aurantii* .

Abundance : During the present work the parasitoid was rarely on *A. aurantii* on *Citrus* sp. in El-Minya and 100 individuals only collected during the period of this study. The percentage of parasitism ranged between 0 and 1.5 %. This species was recorded for the first time in Egypt, associated with *A. aurantii* by Abd-Rabou (1999a).

2. *Coccophagoides kuwanai* (Silvestri)

Diagnosis: Body dark brown, with only the center of the metanotum, legs silvery white, the propodeum yellow; first funicle segment ½ as long as second funcile segment; ovipositor not strongly exerted (Fig.1,b).

Material Examined: 10 ♀♀, 10 ♂♂, Giza,15. VII. 2005 ex. *Quadraspidiotus* sp. on *Cactus* sp.

Distribution: Giza governorate.

Hosts: *Quadraspidiotus* sp.

Abundance: During the present work the parasitoid was very rarely on *Quadraspidiotus* sp. on *Cactus* sp. in Giza and 65 individuals only collected during the period of study. The percentage of parasitism ranged between 0 and 0.5% during the period of this study. This species is recorded only attacking the *Quadraspidiotus* sp. in Egypt (Abd-Rabou, 2000a). This

species was collected for the first time in Egypt, by (Abd-Rabou, 2000a) associated with *Quadraspidiotus* sp.

3. *Coccophagoides similies* (Masi)

Diagnosis: Antennal flagellum spindle-shaped, apical segment conical with pointed apex, the funicle short and think and gradually increasing in width distally, first funicle segment 2/3 as long as the second segment; mesoscutum 10 setae; parapsis 6 setae; submarginal vein 3 setae; ovipositor not strongly exerted (Fig.1,c).

Material Examined: 20♀♀ Northern coast XII. 2005 ex. *P. oleae* on *Olea* sp.

Distribution: Northern Coast region.

Hosts: *P. oleae*.

Abundance : During the present work the parasitoid was rarely on *P. oleae* on *Olea* sp. in Northern coast and 125 individuals only collected during the period of this study and the parasitism rate ranged between 0 and 1.2%. Abd-Rabou (1997a) studied the abundance of this species as a *Coccophagoides* sp. on *P. oleae* in El-Arish and he recorded average and maximum parasitism rates of 5.1 and 10%, respectively. This species was recorded for the first time in Egypt, by (Abd-Rabou, 2000a) associated with *P. oleae*.

4. *Encarsia aurantii* (Howard)

Diagnosis: Face without dark brown cross bands above the toruli, gaster except apex of T7, largely brown to dark brown. Side lobes of mesoscutum each with two or fewer setae. Antennal club 3-segmented, ovipositor very short, clearly much shorter than mid tibia(Fig. 1,d)

Material Examined: 20 ♀♀, Northern Coast, III. 2006, ex. *P. oleae* on *Olea* sp.

Distribution: Beheira, Fayoum, Ismailia, Matruh ,Northern Coast, Qalyubiya and Sharqiya governorates.

Hosts: *A. aurantii*, *Aonidiella orientalis*, *Hemiberlesia latania* (Signort) and *P. oleae*.

Abundance: Data represented in Fig. 2 showed that *E. aurantii* is one of the effective parasitoid attacking some armored scale insects. The parasitoid *E. aurantii* which associated with *P. oleae* infested *Olea* sp. in Northern Coast. The maximum rate of parasitism reached 35% in November,2005. The percentage of parasitism ranged between 2 and 35 % during the period of this study. The highest level of parasitism with *H. lataniae* and *P. oleae* were found to be 61 and 71%, respectively (Abd-Rabou, *et al.*, 2001).'About 44000 individuals of *E.aurantii* was released on olive trees infested by *P.oleae* in Northeren Coast, the parasitism rates increased from 44% to 71% (Abd-Rabou, 2001). This species was recorded for the first time in Egypt by Hafez (1988).

5. *Encarsia berlesei* (Howard)

Diagnosis: Face without dark brown cross bands above the toruli, gaster except apex of T7, largely brown to dark brwon, F1 without any longitudinal sensila, longer than wide, Club narrow and 3-segmetnted side lobes of mesoscutum each with two or fewer setae. Ovipositor either subequal in lenghth to the mid tibia or slightly shorter (Fig.1,e).

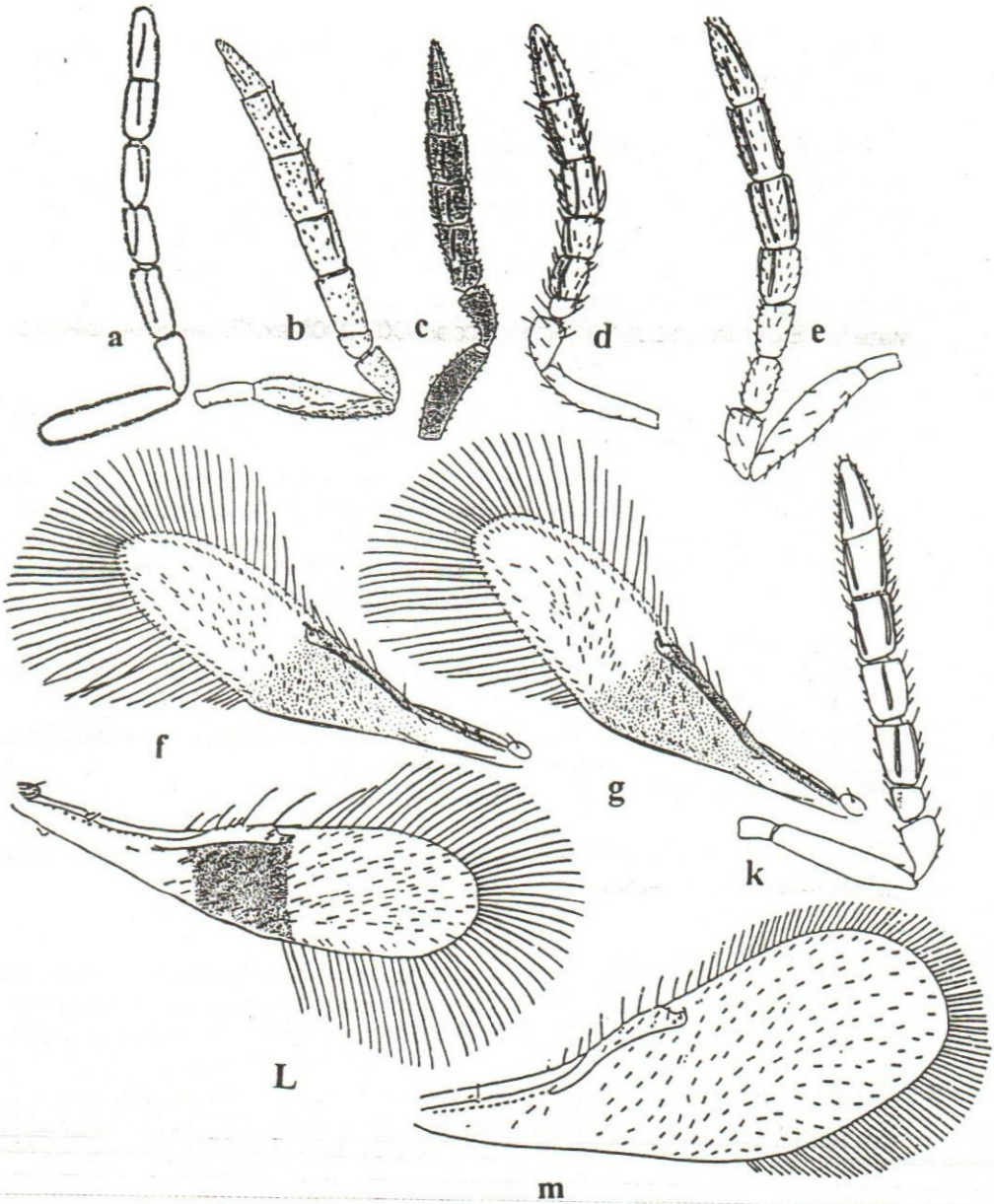

Fig. (1) : The antennae and fore wings forms for different species of subfamily Coccophaginae parasitoids, a: Antennae of *Coccobius* sp., b: Antennae of *Coccophagoids kumanai*, c: Antennae of *Coccophagoids similies*, d: Antennae of *Encarsia aurantii*, e: Antennae of *Encarsia bertesei*, f: Fore wing of *Encarsia citrina* , g: Fore wing of *Encarsia lounsburyi* , k: Antennae of *Encarsia perniciosi*, L: Fore wing of *Pteroptrix aegyptica*, m: Fore wing of *Pteroptrix bicolor* .

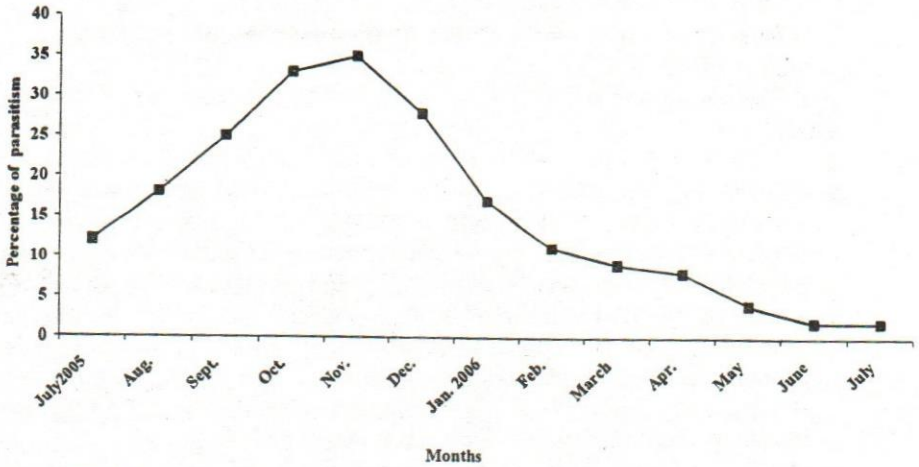

Fig.2: The Percentage of parasitism of *E. aurantii* on *P. oleae* infested Olea sp. in Northern Coast during 2005-2006

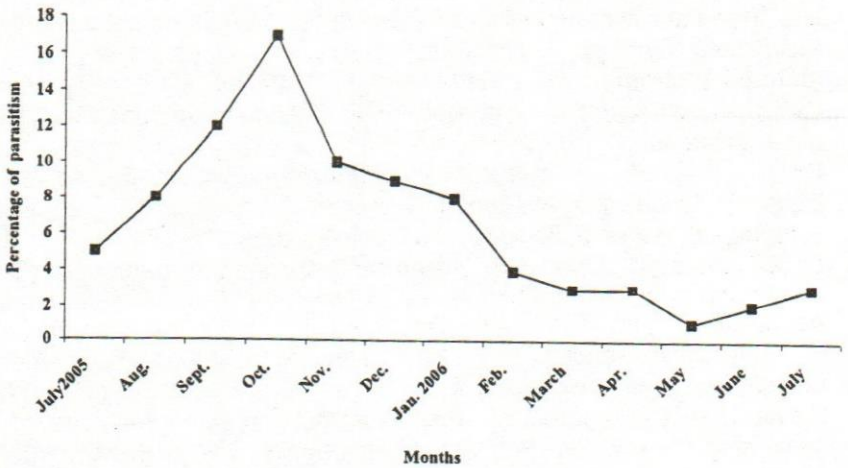

Fig.3: The Percentage of parasitism of *E. berlesei* on *P. pentagona* infested apple in Alexandria during 2005-2006

Material Examined: 20 ♀♀, Alexandria, V. 2005, ex. *P. pentagona* on *Pyrus malus* (apple).

Distribution: Alexandria governorate.

Hosts: *P. pentagona.*

Abundance: The presented data in Fig.3 showed that The maximum rate of parasitism reached 17% in October 2005. The percentage of parasitism ranged between 1 and 17% during the period of this study.This species recorded for the first time in Egypt by Priesner & Hosny (1940). The parasitoid *E. berlesei* which associated with *P. pentagona* infested apple in Alexandria..

6. *Encarsia citrina* (Craw)

Diagnosis: Body largely pale. Longest seta on marginal fringe of fore wing less than the maximum wideth of wing disc. Submarginal vein of fore wing with 2 setae (Fig.1, f).

Material Examined: 20 ♀♀, Dokki (Giza), X. 2005, ex. *P. ziziphi* on *Citrus* sp.

Distribution: Cairo, North Sinai (El-Arish), Giza and Qalyubiya governorates.

Hosts: *A. aurantii, Aspidotus hedreae, Chrysomphalus aonidum* (L.), *Chrysomphalus dictyospermi* (Morgan), *Insulaspis gloveri* (Yackard), *Lepidosaphes beckii* (Newman), *Lindingaspis floridana* Ferris and *P. ziziphi.*

Abundance: Data represented in Fig.4 showed that the parasitoid *E. citrina* which associated with *P. ziziphi* infested *Citrus* sp. in Alexandria. The maximum rate of parasitism reached 26 % in November 2005. The percentage of parasitism ranged between 2 and 26% during the period of this study. Abd-Rabou (1997b) mentioned that *E. citrina* should be considered a promising candidate for utilization in biological control of armored scale insects in Egypt. This species was reared from 8 species of diaspidid scale insects and maximum parasitism rates ranged between 23 and 65%.This species was recorded for the first time in Egypt by Priesner & Hosny (1940).

7. *Encarsia lounsburyi* (Berlese & Paoli)

Diagnosis: Body largely pale, longest seta on marginal fringe of fore wing less than the maximum width of the wing disc. Submarginal vein of fore wing with 1 seta (Fig.1,g).

Material Examined: 20 ♀♀, El-Minya, XI. 1997, ex. *A. aurantii* on *Citrus* sp.

Distribution: Assiut, Aswan, Beni-Suef, El-Minya, Fayoum, Giza and Sohag governorates.

Hosts: *Abgrallaspis cyanophylli (Signoret), A. aurantii, Aspidotus nerii* Bouche, *Chionaspis stantophri* Cooley, *C. aonidum, C. dictyospermi,* D. echinocacti, Fiorinia fioriniae (Targioni-Tozzetti), *H. latania, I. pallidula, L. beckii, Lineaspis striata (Newstead)* and *Mycetaspis personata* (Comstock) (Homoptera: Diaspididae).

Abundance: The represented data in Fig.5 showed that the maximum rate of parasitism reached 31 % in November 2005. The percentage of parasitism ranged between 4 and 31% during the period of this study. Abd-Rabou (2000b) recorded this species associated with 13 species of armored scale insects in Egypt. He observed the effective role of this parasitoid on the armored scale insects. This was recorded for the first time in Egypt by Priesner & Hosny (1940). The parasitoid, *E. lounsburyi* was recorded for the first time associated with *D. echinocacti* by Priesner and Hosny (1940). Later, Abd-Rabou (2003) studied the parasitoids attacking *Diaspis echinocacti* in Egypt. He observed this parasitoid species has a rarely parasitism on this armored scale insect.

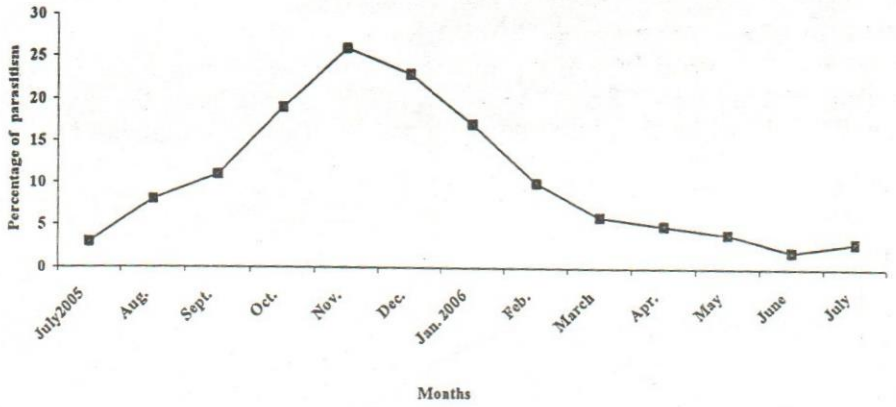

Fig. 4:The percentage of parasitism of *E. citrina* on *P. ziziphi* on *Citrus* sp. in Giza during 2005-2006

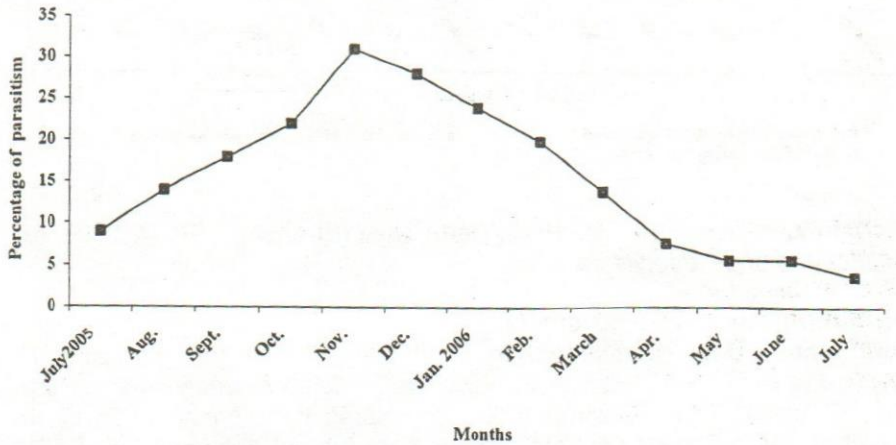

Fig. 5: The percentage of parasitism of *E. lounsburyi* on *A. aurantii* infested *Citrus* sp. in El-Minya during 2005-2006

8. *Encarsia perniciosi* (Tower)

Diagnosis: Antennae with F2 about twice as long as F1 and with 2 linear sensilla . Fore wings 2-3 setae basal to parastigma. Marginal fringe from slightly longer than one sixth to two-fifth of wing width (Fig.1,k).

Material Examined: 20 ♀♀, Sharqyia, I. 2006, ex. *I. pallidula* on *M.indica* .

Distribution: Sharqyia governorate.

Hosts: *I. pallidula*.

Abundance: This parasitoid was collected in a few numbers by the author. This was recorded for the first time in Egypt by Evans and Abd-Rabou(2005).

During the present work the parasitoid was rarely on *I. pallidula* on *M.indica* in Sharqyia and 34 individuals only collected during the period of study. The percentage of parasitism ranged between 0 and 0.2%.

9. *Pteroptrix aegyptica* Evans & Abd-Rabou

Diagnosis: The head brown, the mesoscutum brown with a pale, central triangular-shaped area, F3 and F4 each slightly wider than long , the marginal fringe 0.9-1.0X as long as forewing width and male with F3 quadrate (Fig.1, L).

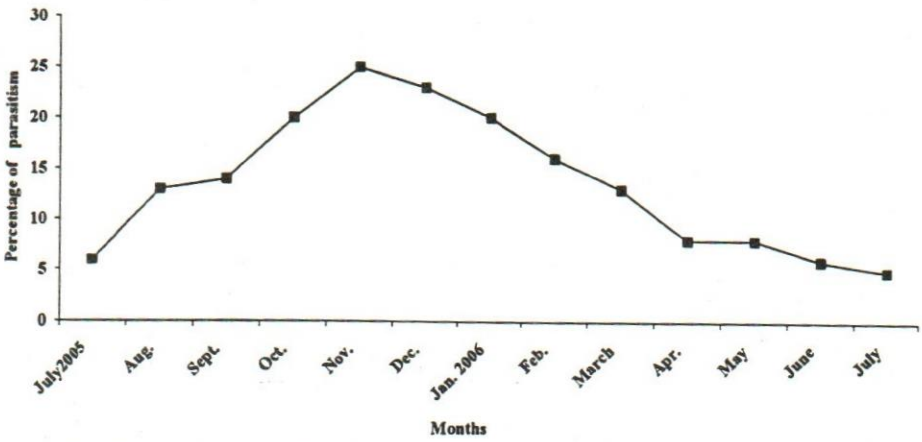

Fig. 6: The percentage of parasitism of *P. aegyptica* on *P. blanchardi* infested *Phoenix dactylifera* in North Sinai during 2005-2006

Material examined :, 10 ♀♀, 10 ♂♂North Sinai (El-Arish) , 10. V. 2006, ex. *P. blanchardi* on *P. dactylifera* .

Hosts : *P. blanchardi.*

Distribution: North Sinai governorate.

Abundance: Data represented in Fig.6 showed that the parasitoid *P. aegyptica* which associated with *P. blanchardi* infested *P. dactylifera* in North Sinai (El-Arish). The maximum rate of parasitism reached 25 % in November 2005. The percentage of parasitism ranged between 5 and 25% during the period of this study. This species was collected in a few numbers by the author. This species was recorded for the first time in Egypt by (Evans and Abd-Rabou, 2005).

10. *Pteroptrix bicolor* (Howard)

Diagnosis: Female antenna 8-segmented, club one-segmented; submarginal vein 2 setae, marginal fringe 3. 1 times as long as the width of disc, mesoscutum 4 setae and axilla two species (Fig. 1,m).

Material Examined: 10 ♀♀, 10 ♂♂, North Sinai (El-Arish), X. 2005, ex. *Parlatoria crotonis* on *Olea* sp.

Distribution: North Sinai (El-Arish) governorate.

Hosts: *Parlatoria crotonis* (Douglas) (Homoptera : Diaspididae).

Abundance : During the present work the parasitoid was rarely on *P. crotonis* on olive in North Sinai (El-Arish) and 88 individuals only collected during the period of this study. The percentage of parasitism ranged between 0 and 0.6 %.This species was collected only associated with *P. crotonis* from North Sinai by small numbers (Abd-Rabou, 1999b). This species was recorded for the first time in Egypt by Abd-Rabou (1999b).

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طفيليات تحت عائلة كوكوفاجنى التى تهاجم الحشرات القشرية المسلحة فى مصر

شعبان محمود عبد ربه و منى عطية محمد مصطفى

معهد بحوث وقاية النباتات – مركز البحوث الزراعية– الدقي– جيزة

الطفيليات التى تتبع تحت عائلة كوكوفاجنى لها دور كبير فى مكافحة الحشرات القشرية المسلحة بيولوجيا فى مصر. و أن هذا العمل تضمن حصر لأنواع طفيليات الكوكوفاجنى التى تهاجم الحشرات القشرية المسلحة فى مصر ودورها فى المكافحة البيولوجية لهذة الآفات. وقد تم عمل دراسات موسمية على الأنواع التى تم تجميعها على ٦ عوائل نباتية ومصابة بثمانية أنواع من الحشرات القشرية المسلحة فى ٧ محافظات. وقد أثبتت النتائج أن أنواع الطفيليات التى تتبع تحت عائلة كوكوفاجنى هى:-

Encarsia aurantii (Howard), *Encarsia berlesei* (Howard), *Encarsia citrina* Craw, *Encarsia lounsburyi* Berlese & Paoli, *Pteroptrix aegyptica* Evans & Abd-Rabou ,*Coccobius* sp.,. *Coccophagoids kumanai* (Silvestri),. *Coccophagoids similies* (Masi), *Encarsia perniciosi* (Tower), *Pteroptrix bicolor* (Howard).

وان أعلى نسبة تطفل للخمسة أنواع الأولى تراوحت ما بين ١٧– ٣٥ % و وأن نسبة التطفل فى بقية الأنواع كانت قليلة.