

**METAPHYCUS ( HYMENOPTERA : ENCYRTIDAE )  
PARASITIDS AS A BIOAGENTS IN CONTROLLING WAX SCALE  
INSECTS, CEROPLASTES SPP. (HEMIPTERA: COCCIDAE)  
ATTACKING SOME ECONOMIC CROPS IN EGYPT**

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**Abstract**

*Ceroplastes* spp. (Hemiptera: Coccidae) are the most important soft scale insects in Egypt. The aim of this work is to study the bionomics of these pests and their *Metaphycus* parasitoid species ( Hymenoptera : Encyrtidae). The results indicated that Genus *Ceroplastes* in Egypt especially *Ceroplastes floridensis* Comstock and *Ceroplastes rusci* (Linnaeus) recorded associated with four species of Genus *Metaphycus* Mercet These are: *Metaphycus flavus* (Howard), *Metaphycus helvolus* (Compere), *Metaphycus lounsburyi* (Howard) and *Metaphycus zebratus* (Mercet). The Results also showed that *C. floridensis* parasitized by *M. flavus*, *M. lounsburyi* and *M.zebratus* and *C. rusci* parasitized by *M. flavus* , *M. helvolus* and *M. zebratus*. While the rest of the member of genus *Ceroplastes* (*Ceroplastes sinensis* Del Guercio, *Ceroplastes cirripediformis* Comstock, *Ceroplastes rubens* Maskel) not parasitized by any species of genus *Metaphycus* in Egypt. The results indicated that the parasitoids emerged from samples of *C. rusci* on *Mangifera indica* in Ismailia were *M. flavus* and *M. helvolus* at an average rate of 5.2 and 0.8 5 for first year and 7.9 and 1.0% for the second year, respectively. Parasitoids that emerged from samples of *C. floridensis* on *Citrus sinensis* in Gharbyia were *M. flavus* and *Metaphycus lounsburyi* at an average rate of 4.6 and 6.4% for first year and 4.1 and 4.5% for the second year, respectively. Parasitoids that emerged from samples of *C. rusci* on *Psidium guajava* in Beni-Suif were *M. flavus* , *M. helvolus* and *M. zebratus* at an average rate of 8.1 , 0.6 and 0.1% for first year and 11.9 , 0.7 and 0.1% for the second year, respectively . It is concluded that the parasitoids *Metaphycus* spp. are the promising bioagents in controlling different species of Genus *Ceroplastes*. Also keys for *Ceroplastes* spp. and their parasitoids *Metaphycus* spp. are included.

**INTRODUCTION**

*Ceroplastes* spp. (Hemiptera: Coccidae) attack sixty four host plants and is distributed in different parts of the world (Hamon & Mason, 1997 and Ben-Dov, 2003). This genus comprises to five species in Egypt, these are *C. cirripediformis* *C. floridensis* , *C. rubens*, *C. rusci* and *C. sinensis*. In recent years, these species are

considered serious pests on different economic crops in Egypt specially, *Citrus* spp., *Psidium guajava* L., *Ficus carica* L., *Mangifera indica* L., *Vitis venifera* L., *Malus sylvestris* Mill. and some ornamental plants (Ozsemerci & Aksit, 2003 and Morsi & Mousa, 2004). Parasitoids of these species were studied by many workers all over the world, i.e. Ben-Dov, (1972), Ulu *et al.* (1972), Zaher & Soliman (1972), Panis (1974), Muzaffar & Ahmad (1977), Oncuer (1977), Kfir and Rosen (1980), Ragab (1995), Shabana & Ragab (1997), Abd-Rabou (2001) and Morsi & Mousa (2004).

Genus *Metaphycus* Mercet (Hymenoptera : Encyrtidae ) is primary parasitoids of soft scale insects specially *Ceroplastes* species. The members of this genus have been used in biocontrol of scale insects . The world species of *Metaphycus* comprises 200 species (Guerrieri & Noyes, 2000), five of them recorded in Egypt ( Abd-Rabou, 1998, 2006). The Role of these parasitoids in controlling wax scale insects studied by van den Bosch (1978), De Bach and Rosen (1991), Noyes and Hayat (1994) and Abd-Rabou (2004),

The present work aims to study the bionomics of these pests and their parasitoids *Metaphycus* species which may give a useful background for the control of these serious pests.

## MATERIALS AND METHODS

### 1. Survey of *Metaphycus* spp. associated with *Ceroplastes* spp. in Egypt

Infested leaves with the *Ceroplastes* spp. were examined in the field, using a pocket lens. The parts of the plant from different crops were collected and placed separately in paper bags for further examination in the laboratory. Specimens were kept in a well-ventilated container until the emergence of any *Metaphycus* parasitoids. Identification of *Metaphycus* was made by examining adults mounted in Hoyers medium and on card as follows: The specimens of *Metaphycus* parasitoids are best preserved as slide mounts and card. It may not be possible to examine 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 the clearing process. It might be necessary to note the colour and sculpture either from dried or freshly collected specimens preserved in alcohol. The small size of specimens and their soft, less sclerotized bodies, make the specimens almost useless for study if preserved in alcohol for longer periods. Dried specimens were soaked in glacial acetic acid (7 drops) to which was added chloral phenol (5 drops) in a small watch glass.

- a. After 48 hours the specimens should be satisfactorily cleared.
- b. The cleared specimens were then mounted in Hoyer's medium.

After drying for about two weeks under 40 °C, the slide cover was ringed with a suitable sealer.

## **2. Key of *Ceroplastes* species**

Identification and key of *Ceroplastes* spp. were followed by Hamon & Williams (1984). Figures adopted from Ezzat & Hussein (1967) and Hamon & Williams (1984).

## **3. Key of *Metaphycus* species**

Identification and key of *Metaphycus* spp. were followed by Abd-Rabou (1998) and Guerrieri & Noyes (2000). Figures adopted from Guerrieri & Noyes (2000).

## **4. Abundance of *Metaphycus* spp. of the *Ceroplastes floridensis* and *Ceroplastes rusci***

The abundance of *Metaphycus* spp. of the *C. floridensis* and *C. rusci* was carried out from 2007 to 2009 on *Citrus* sp. in Ismailiya, *Psidium guajava* in Beni-Suef and *Citrus sinensis* in Gharbyia. Locations heavily infested by the *C. floridensis* and *C. rusci* were selected to make investigations and were sampled monthly. During the study, no chemical control for the pest was performed on these trees. From each location 10 trees were selected randomly for sampling. Units of sampling consisted of 30 leaves. These were detached from the tree and brought to the laboratory for inspection. Each sample was stored in a well-ventilated emergence glass tube and monitored daily for parasitoid emergence. The rate of parasitism was determined by dividing the number of emerging parasitoids from each by the number of scale hosts existing.

Simple correlation and regression values were calculated to obtain information about the relationships between the three tested weather factors and the population of *Metaphycus* spp. of *C. floridensis* and *C. rusci*. The same values were calculated to obtain information about the relationships between the populations of *C. floridensis* and *C. rusci* and their *Metaphycus* parasitoids.

## **RESULTS AND DISCUSSION**

### **1. Survey of *Metaphycus* spp. associated with *Ceroplastes* spp. in Egypt**

As shown in Table (1) genus *Ceroplastes* in Egypt especially species *C. floridensis* and *C. rusci* recorded here associated with four species of Genus *Metaphycus*. These are: *Metaphycus flavus* (Howard), *Metaphycus helvolus* (Compere), *Metaphycus lounsburyi* (Howard) and *Metaphycus zebratus* (Mercet). The Results also showed that *C. floridensis* parasitized by *M. flavus*, *M. lounsburyi* and *M.zebratus* and *C. rusci* parasitized by *M. flavus*, *M. helvolus* and *M. zebratus*. While the rest of the members of genus *Ceroplastes* (*Ceroplastes sinensis* Del Guercio

*Ceroplastes cirripediformis* Comstock, *Ceroplastes rubens* Maskel) not parasitized by any species of genus *Metaphycus* in Egypt.

## 2. Key to *Ceroplastes* spp. in Egypt

1. Tibiotarsal scleroses present, antennae normally 7- segmented .....**2**
  - Tibiotarsal scleroses absent, antennae normally 6- segmented.....**3**
2. Filamentous ducts present on ventral submargin, anal plates with 2 ventral subapical setae ..... ***Ceroplastes sinensis* Del Guercio (Fig.5)**
  - Filamentous ducts absent on ventral submargin, anal plates with 1 ventral subapical setae ..... ***Ceroplastes cirripediformis* Comstock (Fig.1)**
3. Mediodorsal clear area present, ventral tubular ducts absent, legs reduced..... ***Ceroplastes rubens* Maskel (Fig.3)**
  - Mediodorsal clear area absent, ventral tubular ducts present, legs well developed.....  
.....**4**
4. Interantennal setae 3 near each antennal base, dorsal surface submedian areas lacking any kind of disc pores ..... ***Ceroplastes floridensis* Comstock(Fig.2)**
  - Interantennal setae 2 near each antennal base, dorsal surface beset with different kinds of disc pores ..... ***Ceroplastes rusci* (Linnaeus) (Fig.4)**

## 3. Key to *Metaphycus* spp. associated with *Ceroplastes* spp. in Egypt

1. Maxillary palpi 2-segmented, Scape ventrally expanded, at most 2.5X as long as broad, yellowish but largely brown in middle.....  
.....***Metaphycus helvolus* (Compere) (Figs 8-9)**
- Maxillary palpi 3- or 4- segmented.....**2**
2. -Maxillary palpi 4-segmented, Notaular lines complete, meeting at posterior margin of mesoscutum ..... ***Metaphycus zebratus* (Mercet) (Figs12-13)**
  - Maxillary palpi 3- segmented.....**3**
3. Mid and hind tibiae each with 2 dark rings, genae in lower half, with a very narrow, oblique brown stripe extending to upper oral rim.....  
.....***Metaphycus lounsburyi* (Howard) (Figs10-11)**

-Mid and hind tibiae immaculate, genae almost entirely brown in lower half, only F6 with linear sensilla, head and thorax pale yellow, sclerites of thoracic dorsum not edged with brown..... ***Metaphycus flavus* (Howard) (Figs6-7)**

### **3. Abundance of *Metaphycus* spp. of the *Ceroplastes floridensis* and *Ceroplastes rusci***

Parasitoids that emerged from samples of *C. rusci* on *M. indica* in Ismailia were *M. flavus* and *M. helvolus* at an average rate of 5.2 and 0.85 for first year and 7.9 and 1.0% for the second year, respectively (Tables 2&3). There was a maximum parasitism rate of 17.9 and 4.3% for the first year and 20.4 and 2.5% for the second year, respectively (Figs 14&15). Data in Table (4), showed that the simple correlation between maximum, minimum and relative humidity and the populations of *C. rusci* and its parasitoids were positively non-significant ( $r = 0.31, 0.30$  and  $0.21$ ), ( $r = 0.22, 0.27$  and  $0.11$ ) and ( $r = 0.16, 0.30$  and  $0.41$ ), respectively during the 2007-2008 season, also, during 2008-2009 season the simple correlation were positively non-significant ( $r = 0.11, 0.01$  and  $0.23$ ), ( $r = 0.20, 0.16$  and  $0.38$ ) and ( $r = 0.14, 0.56$  and  $0.26$ ) for *C. rusci*, *M. flavus* and *M. helvolus*, respectively. Also, results in Table (5), showed that the simple regression for changing the population of parasitoids (*M. flavus*) on the populations of *C. rusci* were positively significant and non-significant ( $b = 0.50$  and  $0.35$ ) in the two seasons (2007-2008 and 2008-2009), respectively. While, the simple regression for changing the population of parasitoids (*M. helvolus*) on the populations of *C. rusci* were positively non-significant and significant ( $b = 0.38$  and  $0.49$ ) in the two seasons (2007-2008 and 2008-2009), respectively.

Parasitoids that emerged from samples of *C. floridensis* on *C. sinensis* in Gharbyia were *M. flavus* and *M. lounsburyi* at an average rate of 4.6 and 6.4% for first year and 4.1 and 4.5% for the second year, respectively (Tables 6&7). There was a maximum parasitism rate of 13.4 and 14.8% for the first year and 12.4 and 9.7% for the second year, respectively (Figs 16&17). Data in Table (8), showed that the simple correlation between maximum, minimum and relative humidity and the populations of *C. floridensis* and its parasitoids were positively non-significant and significant ( $r = 0.47, 0.50$  and  $0.56$ ), ( $r = 0.03, 0.58$  and  $0.63$ ) and ( $r = 0.58, 0.85$  and  $0.91$ ), respectively during the 2007-2008 season, also, during 2008-2009 season the simple correlation were positively non-significant and significant ( $r = 0.26, 0.49$  and  $0.51$ ), ( $r = 0.29, 0.52$  and  $0.52$ ) and ( $r = 0.37, 0.35$  and  $0.34$ ) for *C. floridensis*, *M. flavus* and *M. lounsburyi*, respectively. Also, results in Table (9), showed that the simple regression for changing the population of parasitoids (*M. flavus*) on the populations of *C. floridensis* were positively non-significant and significant ( $b = 0.44$  and  $0.49$ ) in the two seasons (2007 and 2008), respectively. While, the simple regression for changing the population of parasitoids (*M. lounsburyi*) on the populations of *C. floridensis* were

positively significant ( $b = 0.56$  and  $0.57$ ) in the two seasons (2007-2008 and 2008-2009), respectively.

Parasitoids that emerged from samples of *C. rusci* on *P.guajava* in Beni-Suif were *M. flavus* , *M. helvolus* and *M. zebratus* at an average rate of 8.1 , 0.6 and 0.1% for first year and 11.9 , 0.7 and 0.1% for the second year, respectively (Tables 10&11). There was a maximum parasitism rate of 20.4, 1.4 and 0.6% for the first year and 27.1, 1.5 , and 0.7 % for the second year, respectively (Figs 18&19) .

Data in Table (12), showed that the simple correlation between maximum, minimum and relative humidity and the mean numbers of *C. rusci* and its parasitoids were positively non-significant ( $r = 0.04, 0.15, 0.31$  and  $0.32$ ), ( $r = 0.40, 0.16, 0.65$  and  $0.03$ ) and ( $r = 0.29, 0.28, 0.65$  and  $0.03$ ), respectively during the 2007-2008 season, also, during 2008-2009 season the simple correlation were positively non-significant and significant ( $r = 0.03, 0.19, 0.61$  and  $0.22$ ), ( $r = 0.28, 0.58, 0.85$  and  $0.36$ ) and ( $r = 0.28, 0.31, 0.64$  and  $0.25$ ) for *C. rusci*, *M. flavus*, *M. helvolus* and *M. zebratus*, respectively. Also, results in Table (13), showed that the simple regression for changing the population of parasitoids (*M. flavus*) on the populations of *C. rusci* were positively non-significant ( $b = 0.25$  and  $0.37$ ) in the two seasons (2007-2008 and 2008-2009), respectively. While, the simple regression for changing the population of parasitoids (*M. helvolus*) on the populations of *C. rusci* were positively non-significant ( $b = 0.24$  and  $0.33$ ) in the two seasons (2007-2008 and 2008-2009), respectively. While, the simple regression for changing the population of parasitoids (*M. zebratus*) on the populations of *C. rusci* also were positively and non-significant ( $b = 0.12$  and  $0.12$ ) in the two seasons (2007 and 2008), respectively.

The present work indicated that parasitoids emerged from samples of *C. floridensis* on *C. sinensis* in Gharbyia were *M. flavus* and *M.lounsburyi* at an average rate of 4.6 and 6.4% for first year and 4.1 and 4.5% for the second year, respectively. There was a maximum parasitism rate of 13.4 and 14.8% for the first year and 12.4 and 9.7% for the second year, respectively . Hafez *et al.* (1987) recorded *M. flavus* attacking *C. floridensis*. The parasitoid, *M. flavus* associated with different species of soft scale insects in Alexandria (Abou El-Khair, 1999). Morsi (1999) recorded *M. helvolus*, *M. zebratus*, *M. flavus*, associated with *C. rusci* in Beni-Suef. While in this work parasitoids that emerged from samples of *C. rusci* on *P.guajava* in Beni-Suif were parasitized by *M. flavus* , *M. helvolus* and *M. flavus* parasitized *C. floridness* attacking citrus by 18.2% / 30 leaves and 15 twigs in Garbiya governorate. While In Behira governorate *C. floridness* *M. lounsburyi*, *M. flavus* and *M. zebratus* with an average parasitism rates, 2.8, 0.9, 0.9%/ 30 leaves and 15 twigs In Giza *C. floridness* parasitized by *M. zebratus* only with an average parasitism rates, 0.7% /30 leaves and 15 twigs (Abd-Rabou, 2001). The results here observed parasitoids emerged from

samples of *C. rusci* on *M. indica* in Ismailia were that *M. flavus* and *M. helvolus* at an average rate of 5.2 and 0.85 for first year and 7.9 and 1.0% for the second year, respectively. There was a maximum parasitism rate of 17.9 and 4.3% for the first year and 20.4 and 2.5% for the second year, respectively. While, Morsi and Mousa (2004) stated that *C. rusci* parasitized by *M. flavus*, *M. helvolus*, *M. zebratus* with an average parasitism rates 9.17, 4.53, 2.84% /100 leaves.

Table 1

Table 1. Survey of *Metaphycus* spp. associated with *Ceroplastes* spp. in Egypt

| <i>Metaphycus</i> spp.                | <i>Ceroplastes</i> spp.        | Host plant           |                         | Loactions        |                      | Date              |
|---------------------------------------|--------------------------------|----------------------|-------------------------|------------------|----------------------|-------------------|
|                                       |                                | Family               | Species                 | Governorate      | Location             |                   |
| <i>Metaphycus flavus</i> (Howard)     | <i>Ceroplastes floridensis</i> | <i>Rutaceae</i>      | <i>Citrus sp.</i>       | <i>Behira</i>    | <i>Rashid</i>        | <i>June, 2008</i> |
|                                       | <i>C. floridensis</i>          | <i>Rutaceae</i>      | <i>Citrus sinensis</i>  | <i>Gharbyia</i>  | <i>Kafr El-Zayat</i> | <i>Sept. 2008</i> |
|                                       | <i>C. rusci</i>                | <i>Anacardiaceae</i> | <i>Mangifera indica</i> | <i>Ismailiya</i> | <i>Ismailiya</i>     | <i>Nov., 2007</i> |
|                                       | <i>Ceroplastes rusci</i>       | <i>Anacardiaceae</i> | <i>Ficus sycomorus</i>  | <i>Giza</i>      | <i>Dokki</i>         | <i>Jan., 2008</i> |
|                                       | <i>C. rusci</i>                | <i>Myrtaceae</i>     | <i>Psidium guajava</i>  | <i>Beni-Suif</i> | <i>Biba</i>          | <i>Sep., 2007</i> |
| <i>Metaphycus helvolus</i> (Compere)  | <i>C. rusci</i>                | <i>Anacardiaceae</i> | <i>Mangifera indica</i> | <i>Ismailiya</i> | <i>Ismailiya</i>     | <i>Nov., 2007</i> |
|                                       | <i>C. rusci</i>                | <i>Myrtaceae</i>     | <i>Psidium guajava</i>  | <i>Beni-Suif</i> | <i>Biba</i>          | <i>Sep., 2007</i> |
| <i>Metaphycus lounsburyi</i> (Howard) | <i>C. floridensis</i>          | <i>Rutaceae</i>      | <i>Citrus sp.</i>       | <i>Behira</i>    | <i>Rashid</i>        | <i>June, 2007</i> |
|                                       | <i>C. floridensis</i>          | <i>Rutaceae</i>      | <i>Citrus sinensis</i>  | <i>Gharbyia</i>  | <i>Kafr El-Zayat</i> | <i>July, 2009</i> |
| <i>Metaphycus zebratus</i> (Mercet)   | <i>C. floridensis</i>          | <i>Rutaceae</i>      | <i>Citrus sp.</i>       | <i>Behira</i>    | <i>Rashid</i>        | <i>June, 2007</i> |
|                                       | <i>C. floridensis</i>          | <i>Rutaceae</i>      | <i>Citrus sp.</i>       | <i>Giza</i>      | <i>El-Saf</i>        | <i>June, 2007</i> |
|                                       | <i>C. rusci</i>                | <i>Anacardiaceae</i> | <i>Ficus carica</i>     | <i>Matruh</i>    | <i>Matruh</i>        | <i>Oct., 2008</i> |
|                                       | <i>C. rusci</i>                | <i>Myrtaceae</i>     | <i>Psidium guajava</i>  | <i>Beni-Suif</i> | <i>Biba</i>          | <i>Sep., 2007</i> |



Table 2. Parasitism of *Ceroplastes rusci* by *Metaphycus* spp. on *Mangifera indica* in Ismailia during 2007-2008.

| Dates        | Mean No. of <i>C. Rusci</i> 30 leaves | Parasitoids              |                            |
|--------------|---------------------------------------|--------------------------|----------------------------|
|              |                                       | <i>Metaphycus flavus</i> | <i>Metaphycus helvolus</i> |
| May, 2007    | 581                                   | 0.2                      | 0.0                        |
| June         | 877                                   | 1.2                      | 0.0                        |
| July         | 915                                   | 4.0                      | 0.1                        |
| August       | 1212                                  | 6.4                      | 0.5                        |
| September    | 1347                                  | 11.5                     | 1.2                        |
| October      | 1478                                  | 17.9                     | 4.3                        |
| November     | 988                                   | 11.5                     | 2.1                        |
| December     | 656                                   | 5.3                      | 0.7                        |
| January 2008 | 989                                   | 3.1                      | 0.1                        |
| February     | 1014                                  | 0.7                      | 0.0                        |
| March        | 1118                                  | 0.6                      | 0.0                        |
| April        | 658                                   | 0.4                      | 0.0                        |

Table 3. Parasitism of *Ceroplastes rusci* by *Metaphycus* spp. on *Mangifera indica* in Ismailia during 2008-2009.

| Dates        | Mean No. of <i>C. rusci</i> 30 leaves | Parasitoids              |                            |
|--------------|---------------------------------------|--------------------------|----------------------------|
|              |                                       | <i>Metaphycus flavus</i> | <i>Metaphycus helvolus</i> |
| May, 2008    | 622                                   | 0.5                      | 0.1                        |
| June         | 914                                   | 2.1                      | 0.7                        |
| July         | 1015                                  | 3.4                      | 0.9                        |
| August       | 1346                                  | 7.9                      | 1.0                        |
| September    | 1578                                  | 13.5                     | 1.6                        |
| October      | 1690                                  | 20.4                     | 2.5                        |
| November     | 1034                                  | 16.5                     | 1.9                        |
| December     | 756                                   | 11.7                     | 1.0                        |
| January 2009 | 1023                                  | 9.1                      | 0.5                        |
| February     | 1193                                  | 4.6                      | 0.3                        |
| March        | 1345                                  | 4.0                      | 1.0                        |

|       |     |     |     |
|-------|-----|-----|-----|
| April | 789 | 1.1 | 0.0 |
|-------|-----|-----|-----|

Table 4. Simple correlation values of some climatic factors on the population of *Ceroplastes rusci* and its parasitoids on *Mangifera indica* in Ismailia during 2007-2008 and 2008-2009.

| Insect species             | 1 <sup>st</sup> Season |                    |                    | 2 <sup>nd</sup> Season |                    |                    |
|----------------------------|------------------------|--------------------|--------------------|------------------------|--------------------|--------------------|
|                            | Max. temp.             | Min. temp.         | R.H.               | Max. temp.             | Min. temp.         | R.H.               |
| <i>Ceroplastes rusci</i>   | 0.31 <sup>ns</sup>     | 0.22 <sup>ns</sup> | 0.16 <sup>s</sup>  | 0.11 <sup>ns</sup>     | 0.20 <sup>ns</sup> | 0.14 <sup>ns</sup> |
| <i>Metaphycus flavus</i>   | 0.30 <sup>ns</sup>     | 0.27 <sup>ns</sup> | 0.30 <sup>ns</sup> | 0.01 <sup>ns</sup>     | 0.16 <sup>ns</sup> | 0.56 <sup>ns</sup> |
| <i>Metaphycus helvolus</i> | 0.21 <sup>ns</sup>     | 0.11 <sup>ns</sup> | 0.41 <sup>ns</sup> | 0.23 <sup>ns</sup>     | 0.38 <sup>ns</sup> | 0.26 <sup>ns</sup> |

Table 5. Simple correlation and regression values of parasitoids on the population of *Ceroplastes rusci* on *Mangifera indica* in Ismailia during 2007-2008 and 2008-2009.

| Parasitoids                | 1 <sup>st</sup> Season   | 2 <sup>nd</sup> Season |
|----------------------------|--------------------------|------------------------|
|                            | <i>Metaphycus flavus</i> | 0.50*                  |
| <i>Metaphycus helvolus</i> | 0.38 <sup>ns</sup>       | 0.49*                  |

Table 6. Parasitism of *Ceroplastes floridensis* by *Metaphycus* spp. on *Citrus sinensis* in Gharbyia during 2007-2008.

| Dates        | Mean No. of <i>C. floridensis</i> 30 /leaves | Parasitoids              |                             |
|--------------|--|--------------------------|-----------------------------|
|              |  | <i>Metaphycus flavus</i> | <i>Metaphycus lounsbryi</i> |
| May, 2007    | 434  | 1.8                      | 3.5                         |
| June         | 645  | 2                        | 4.8                         |
| July         | 838  | 5.1                      | 7.1                         |
| August       | 989  | 7.9                      | 10.9                        |
| September    | 1567   | 13.3                     | 17.8                        |
| October 2008 | 1256   | 10.4                     | 12.4                        |

|          |      |     |     |
|----------|------|-----|-----|
| February | 964  | 1.1 | 3.2 |
| March    | 1023 | 0.4 | 1.4 |
| April    | 758  | 0.1 | 1.0 |

Table 7. Parasitism of *Ceroplastes floridensis* by *Metaphycus* spp. on *Citrus sinensis* in Gharbyia during 2008-2009.

| Dates        | Mean No. of <i>C. floridensis</i> /leaves | Parasitoids              |                              |
|--------------|---|--------------------------|------------------------------|
|              |   | <i>Metaphycus flavus</i> | <i>Metaphycus lounsburyi</i> |
| May, 2008    | 624                                       | 1.3                      | 2.1                          |
| June         | 934                                       | 1.8                      | 3.1                          |
| July         | 1189                                      | 4.2                      | 5.1                          |
| August       | 1411                                      | 6.8                      | 7.5                          |
| September    | 1634                                      | 12.4                     | 9.7                          |
| October      | 1567                                      | 8.4                      | 7.5                          |
| November     | 967                                       | 5.2                      | 7.1                          |
| December     | 734                                       | 3.1                      | 3.5                          |
| January 2009 | 916                                       | 1.9                      | 3.1                          |
| February     | 1134                                      | 1.8                      | 2.5                          |
| March        | 1346                                      | 1.0                      | 0.9                          |
| April        | 749                                       | 0.9                      | 1.7                          |

Table 8. Simple correlation values of some climatic factors on the population of *Ceroplastes floridensis* by *Metaphycus* spp. on *Citrus sinensis* in Gharbyia during 2007-2008 and 2008-2009.

| Pest                           | 1 <sup>st</sup> Season |                    |         | 2 <sup>nd</sup> Season |                    |                    |
|--------------------------------|------------------------|--------------------|---------|------------------------|--------------------|--------------------|
|                                | Max. temp.             | Min. temp.         | R.H.    | Max. temp.             | Min. temp.         | R.H.               |
| <i>Ceroplastes floridensis</i> | 0.47 <sup>ns</sup>     | 0.03 <sup>ns</sup> | 0.58*   | 0.26 <sup>ns</sup>     | 0.29 <sup>ns</sup> | 0.37 <sup>ns</sup> |
| <i>Metaphycus flavus</i>       | 0.50 <sup>ns</sup>     | 0.58*              | 0.85*** | 0.49 <sup>ns</sup>     | 0.52*              | 0.35 <sup>ns</sup> |
| <i>Metaphycus lounsburyi</i>   | 0.56*                  | 0.63*              | 0.91*** | 0.51*                  | 0.52*              | 0.34 <sup>ns</sup> |

Table 9. Simple correlation and regression values of parasitoids on the population of *Ceroplastes floridensis* by *Metaphycus* spp. on *Citrus sinensis* in Gharbyia during 2007-2008 and 2008-2009.

| Parasitoids                  | 1 <sup>st</sup><br>Season | 2 <sup>nd</sup><br>Season |
|------------------------------|---------------------------|---------------------------|
| <i>Metaphycus flavus</i>     | 0.44 <sup>ns</sup>        | 0.56*                     |
| <i>Metaphycus lounsburyi</i> | 0.49*                     | 0.57*                     |

Table 10. Parasitism of *Ceroplastes rusci* by *Metaphycus* spp. on *Psidium guajava* in Beni-Suif during 2007-2008.

| Dates        | Mean No. of <i>C. rusci</i> 30 /leaves | Parasitoids              |                            |                            |
|--------------|--|--------------------------|----------------------------|----------------------------|
|              |  | <i>Metaphycus flavus</i> | <i>Metaphycus helvolus</i> | <i>Metaphycus zebratus</i> |
| May, 2007    | 467                                    | 2.2                      | 0.1                        | 0                          |
| June         | 679                                    | 3.4                      | 0.4                        | 0                          |
| July         | 890                                    | 5.1                      | 0.8                        | 0                          |
| August       | 978                                    | 7.1                      | 0.9                        | 0                          |
| September    | 1023                                   | 11.2                     | 1.1                        | 0                          |
| October      | 1195                                   | 14.2                     | 1.1                        | 0                          |
| November     | 857                                    | 20.4                     | 1.4                        | 0.6                        |
| December     | 569                                    | 14.1                     | 0.7                        | 0.3                        |
| January 2008 | 780                                    | 8.1                      | 0.6                        | 0.1                        |
| February     | 912                                    | 5.5                      | 0                          | 0                          |
| March        | 998                                    | 3.1                      | 0                          | 0                          |
| April        | 523                                    | 3                        | 0                          | 0                          |

Table 11. Parasitism of *Ceroplastes rusci* by *Metaphycus* spp. on *Psidium guajava* in Beni-Suif during 2008-2009.

| Dates        | Mean No. of <i>C. rusci</i> 30 /leaves | Parasitoids              |                    |                    |
|--------------|--|--------------------------|--------------------|--------------------|
|              |  | <i>Metaphycus flavus</i> | <i>M. helvolus</i> | <i>M. zebratus</i> |
| May, 2008    | 487                                    | 4.1                      | 0.3                | 0                  |
| June         | 623                                    | 5.6                      | 0.5                | 0                  |
| July         | 864                                    | 6.4                      | 1                  | 0                  |
| August       | 945                                    | 8.5                      | 1.5                | 0                  |
| September    | 1023                                   | 13.4                     | 1.4                | 0                  |
| October      | 1156                                   | 17.1                     | 1.3                | 0                  |
| November     | 856                                    | 27.1                     | 1.5                | 0                  |
| December     | 579                                    | 20.7                     | 0.8                | 0.7                |
| January 2009 | 812                                    | 15.7                     | 0.4                | 0.2                |
| February     | 923                                    | 10.4                     | 0.1                | 0.1                |
| March        | 998                                    | 8.7                      | 0                  | 0                  |

|       |     |     |   |   |
|-------|-----|-----|---|---|
| April | 535 | 5.5 | 0 | 0 |
|-------|-----|-----|---|---|

Table 12. Simple correlation values of some climatic factors on the population of *Ceroplastes rusci* by *Metaphycus* spp. on *Psidium guajava* in Beni-Suif during 2007-2008 and 2008-2009.

| Pest                       | 1 <sup>st</sup><br>Season |                    |                    | 2 <sup>nd</sup><br>Season |                    |                    |
|----------------------------|---------------------------|--------------------|--------------------|---------------------------|--------------------|--------------------|
|                            | Max.<br>temp.             | Min.<br>temp.      | R.H.               | Max.<br>temp.             | Min.<br>temp.      | R.H.               |
| <i>Ceroplastes rusci</i>   | 0.04 <sup>ns</sup>        | 0.40 <sup>ns</sup> | 0.29 <sup>ns</sup> | 0.03 <sup>ns</sup>        | 0.28 <sup>ns</sup> | 0.28 <sup>ns</sup> |
| <i>Metaphycus flavus</i>   | 0.15 <sup>ns</sup>        | 0.16 <sup>ns</sup> | 0.28 <sup>ns</sup> | 0.19 <sup>ns</sup>        | 0.58*              | 0.31 <sup>ns</sup> |
| <i>Metaphycus helvolus</i> | 0.31 <sup>ns</sup>        | 0.56 <sup>ns</sup> | 0.65 <sup>+</sup>  | 0.61*                     | 0.85 <sup>ns</sup> | 0.64*              |
| <i>Metaphycus zebratus</i> | 0.32 <sup>ns</sup>        | 0.12 <sup>ns</sup> | 0.03 <sup>ns</sup> | 0.22 <sup>ns</sup>        | 0.36 <sup>ns</sup> | 0.25 <sup>ns</sup> |

Table 13. Simple correlation and regression values of parasitoids on the mean numbers of *Ceroplastes rusci* by *Metaphycus* spp. on *Psidium guajava* in Beni-Suif during 2007-2008 and 2008-2009.

| Parasitoids                | 1 <sup>st</sup><br>Season | 2 <sup>nd</sup><br>Season |
|----------------------------|---------------------------|---------------------------|
| <i>Metaphycus flavus</i>   | 0.25 <sup>ns</sup>        | 0.37 <sup>ns</sup>        |
| <i>Metaphycus helvolus</i> | 0.24 <sup>ns</sup>        | 0.33 <sup>ns</sup>        |
| <i>Metaphycus zebratus</i> | 0.12 <sup>ns</sup>        | 0.12 <sup>ns</sup>        |

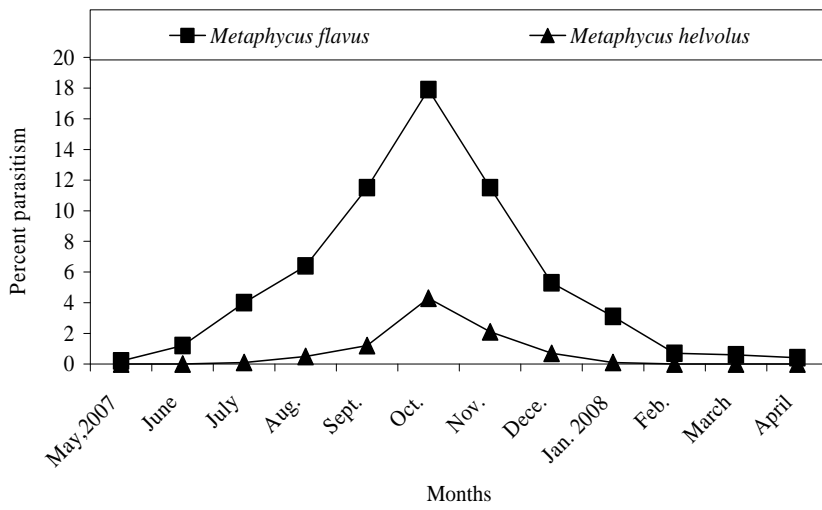


Fig. 14. Percent parasitism of *Ceroplastes rice* by *Metaphycus* spp. on *Mangifera indica* in Ismailia during 2007-2008.

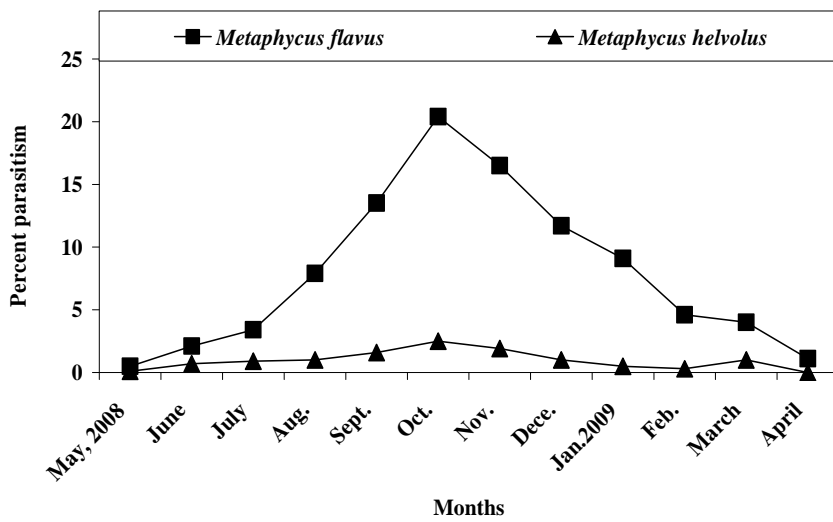


Fig. 15. Percent parasitism of *Ceroplastes rice* by *Metaphycus* spp. on *Mangifera indica* in Ismailia during 2008-2009.

METAPHYCUS ( HYMENOPTERA : ENCYRTIDAE ) PARASITIDS AS A BIOAGENTS  
 IN CONTROLLING WAX SCALE INSECTS, CEROPLASTES SPP.  
 (HEMIPTERA: COCCIDAE) ATTACKING SOME ECONOMIC CROPS IN EGYPT

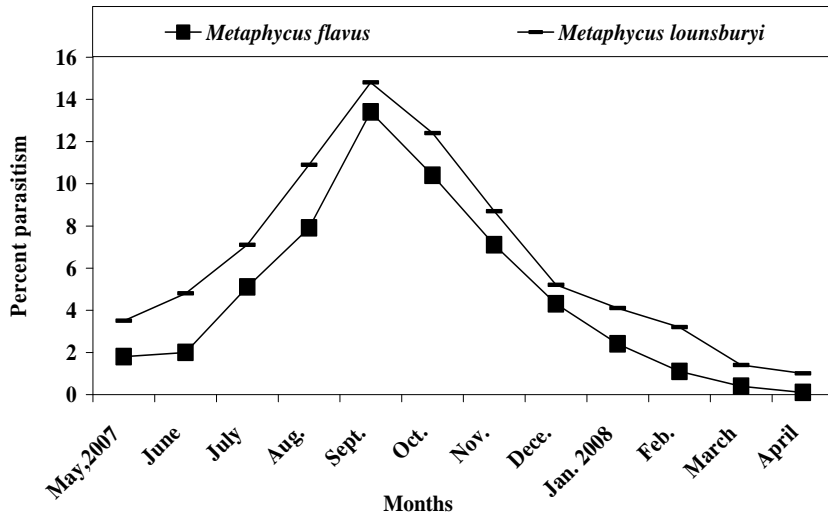


Fig. 16. Percent parasitism of *Ceroplastes floridensis* by *Metaphycus* spp. on *Citrus sinensis* in Gharbyia during 2007-2008.

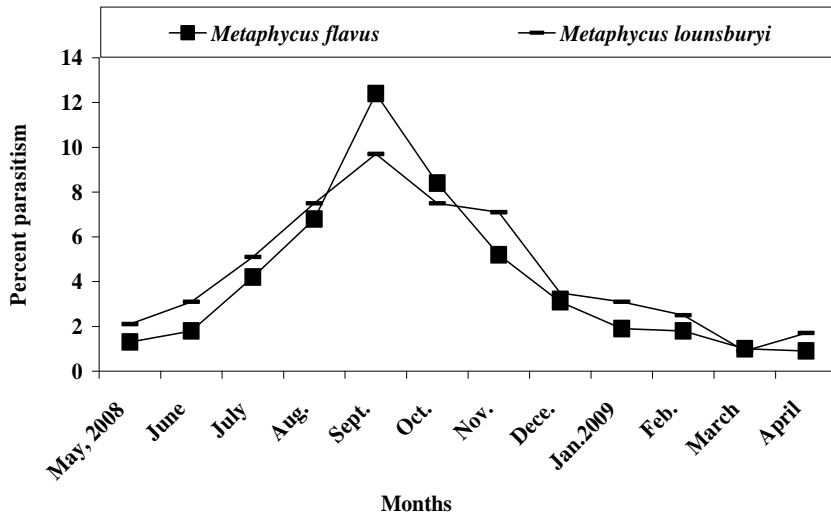


Fig. 17. Fig. 16. Percent parasitism of *Ceroplastes floridensis* by *Metaphycus* spp. on *Citrus sinensis* in Gharbyia during 2008-2009.

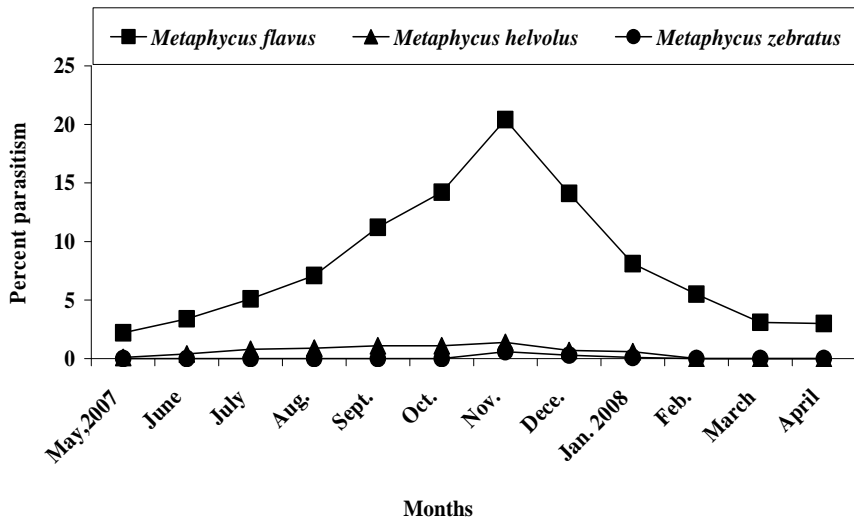


Fig. 18. Percent parasitism of *Ceroplastes rusci* by *Metaphycus* spp. on *Psidium guajava* in Beni-Suif during 2007-2008.

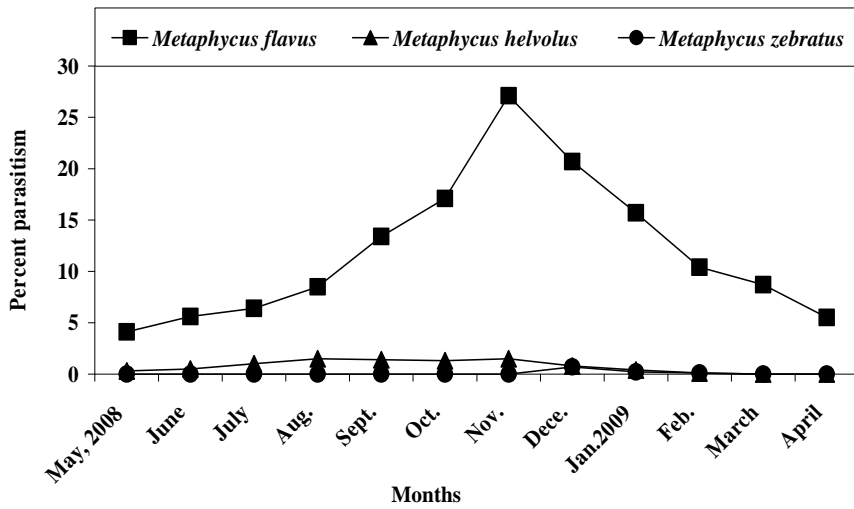


Fig. 19. Percent parasitism of *Ceroplastes rusci* by *Metaphycus* spp. on *Psidium guajava* in Beni-Suif during 2008-2009.



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## طفيليات جنس ميتافيكس كأحد العناصر البيولوجية فى مكافحة الحشرات الشمعية الرخوة على بعض المحاصيل الأقتصادية فى مصر

شعبان عبدربه ، نادية على

معهد بحوث وقاية النباتات - مركز البحوث الزراعية- الدقي- الجيزة

الحشرات الشمعية الرخوة من أهم الآفات الضارة التى تصيب العديد من المحاصيل الأقتصادية فى مصر و فى هذا البحث تم عمل حصر للحشرات الشمعية وطفيلياها من جنس ميتافيكس فى مصر . الى جانب هذا تم عمل دراسات موسمية على تعداد طفيليات جنس ميتافيكس. وقد أتضح من النتائج أن هذه الافات يتطفل عليها أربع انواع من جنس ميتافيكس .أما الدراسة الموسمية لطفيليات جنس ميتا فيكس فى محافظات الأسماعيلية و الغربية و بنى سويف على آفات الحشرات الشمعية فقد أوضحت أن نسب التطفل تراوحت ما بين 0.01 – 8.1% و 4.6 - 6.4% و 0.8 - 5.2% على الترتيب. و يتضح من هذا العمل أن طفيليات جنس ميتا فيكس لها دور فعال فى مكافحة الحشرات الشمعية فى مصر. هذا وقد تضمن العمل أيضا مفاتيح تصنيفية للحشرات الشمعية وطفيلياتها من جنس ميتافيكس فى مصر.