



Survey and distribution density of genus *Brachymeria* species (Hymenoptera: Chalcididae) in Egypt

Mohammed, Abd El-Salam¹; Fawzy, F. Shalaby²; Eman, I. El-Sebaey¹ and Adel, A. Hafez²

¹Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

²Faculty of Agriculture, Banha University, Egypt.

ARTICLE INFO

Article History

Received: 15/ 2 / 2020

Accepted: 22/ 3 /2020

Keywords

Chalcididae, *Brachymeria*, parasitoid, hosts, distribution, density and ecosystem.

Abstract:

Surveys of *Brachymeria* (Hymenoptera: Chalcididae) parasitoids attack larvae and pupae of Lepidoptera, Diptera and Coleoptera were conducted in the Egypt between 2014 and 2018. The population density of *Brachymeria* was counted in Egypt. Data on distribution of 12 *Brachymeria* wasp species provides. In this study, field experiments were undertaken during 2014 and 2016 seasons in Monoufia, Qalubiya and Giza Governorates. The obtained results indicated that pupae of *Pieris rapae* (Linnaeus) (Lepidoptera: Pieridae) and *Earias insulana* (Boisduval) (Lepidoptera: Noctuidae), were obtained. The highest mean parasitism percentage was recorded at sowing during September 2014 and 2015 cabbage growing seasons (28.49% at 2014 and 24.46% in 2015) respectively by *Brachymeria femorata* (Panzer) (Hymenoptera: Chalcididae). The highest mean parasitism percentage was recorded in Qalubiya Governorate during 2015 in cotton growing seasons (4.76%) followed by Giza Governorate during 2016 in cotton growing seasons (4.47%) by *Brachymeria brevicornis* (Klug) (Hymenoptera: Chalcididae).

Introduction

Hymenopterous parasitoids have immense importance in natural and agricultural ecosystems, where they influence or regulate the population density of many pests (Godfray, 1994). Chalcidids comprise a very important beneficial group of parasitoids as many species of the family are important

parasitoids that have been used successfully for the biological control of many insect pest species. The genus *Brachymeria* Westwood, 1829 belongs to the subfamily Chalcidinae. Apparently, there are almost 300 species of *Brachymeria* in the world (Noyes, 2011) of which many are economically

important as they are used in the biological control as entomophagous against insect pests. These chalcids parasitize the mature larvae and pupae of the wide range species of various orders. They play significant role in the ecosystem of various economically important crops.

In Egypt *Brachymeria* includes the most common and widely taxa distributed in the family Chalcididae and worldwide. Many species of this genus are primary endoparasitoids of lepidopterous families; Diptera (Fam. Sarcophagidae) and Coleopterous families. On the other hand, sometime hyperparasitic species are found to parasitise Diptera (Tachinidae) and Ichneumonid (Hymenoptera). *Brachymeria* taxa look very much alike, but they differ widely in habits. Therefore, the precise determination of the species concerned is highly important in any host-parasite study for biological control involving this genus (Joseph *et al.*, 1973). Accurate techniques to detect and identify parasitoids are a prerequisite for understanding and managing host-parasitoid interactions: for example, they are needed to measure and monitor parasitism rates (Agusti *et al.*, 2005). Studies on the ecology of parasitoids can supply the basic information necessary for biological control and for its efficient operations as strategy point undertaking integrated control plan in Egypt, where the losses suffered due to damage to crops by insect pests are often enormous in addition to prolonged effects and hazards of chemical control on the ecosystem.

Materials and methods

1. Survey of parasitoid with host's identification:

Throughout the period from September, 2013 to May 2018,

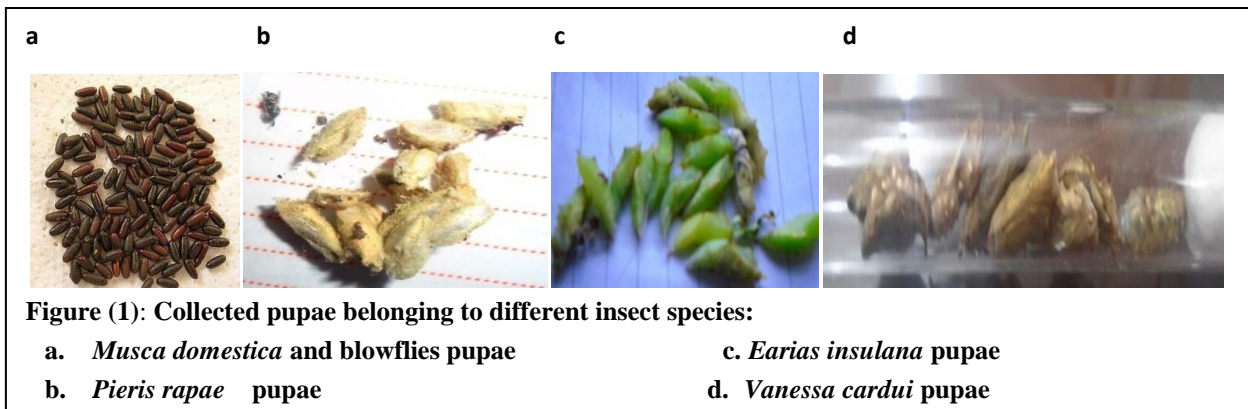
inspections of cultivated plants covered some Egyptian area that have variable climate due to different ecological zones (Beheira, Qalubiya, Monoufia, Giza, Asiat, Fayoum, Cairo, Kafr El Sheikh, Sharqia, Mersa Matruh, Arish). The represented crops were; cotton (*Gossypium hirsutum*), cabbage (*Brassica oleracea*), vegetable marrow (*Cucurbita pepo*), sunflower (*Helianthus annuus*), faba bean (*Vicia faba*), Egyptian mallow (*Malva parviflora*), okra (*Abelmoschus esculentus*), oboe cane (*Arundo donax*), clover (*Trifolium alexandrinum*), wheat (*Triticum aestivum*), rice (*Oryza sativa*), peanuts (*Arachis hypogaea*), pampas grass (*Cortaderia selleana*) plants and maize (*Zea mays*), sesame (*Sesamum indicum*), some fruit trees, some weeds and some ornamental plants, In addition to chicken wastes, the waste of the altars and some animal jeff. The host plants were examined with the naked eye to collect Lipedopteran, Coelopteran and Dipteran last stage larvae and pupae (Figure, 1). Sampling was carried out using sweeping net in the morning (Figure, 2). The pitfall traps were used to collect occurring chalcidid parasitoids especially *Brachymeria* wasps. Light traps were also used in the following areas (Armei, Khorshed, Qutur, Al Santah, El Qanater El Khayreya, Dishna, Desert Research Center Farm (El Sadat City), International Raghy Farm, Marsa Alam, Abo Simbol, Qus, Edfu, Safaga and Aswan). The traps covered all months of this year. Survey operations were usually carried out on experimental plots that are often not treated with pesticides as well as months or period in which the pesticide use is less or less effective during the period of plant life. In order to obtain the parasitoids, the trapped insects, were gently placed

in taken by glass tubes (10cm) (containing KCN at the bottom) until mortality of insects inside. killing purpose. Specimens were preserved in 75% alcohol until they were mounted on cards. Different specimens were collected from diverse ecological zones of Egyptian Governorates. The collected specimens were labeled, indentified and recorded along with the relevant data of localities, date of collection and hosts. The identifications or compare of specimens were, mostly, carried out using Bouček (1952, 1956,1988); Habu (1960); Masi (1929a,b, 1936); Nikol'skaya (1952); Steffan (1959); Joseph *et al.* (1973) and Narendran and Achterberg (2016). Material examined in this study was deposited in the collection of Agriculture Research Center, Researches Institute of Plants Protection Insect, Taxonomy Department (Giza). All *Brachymeria* species that saved in main collection of Egyptian Agriculture Ministry collected by both Mabrouk, Alfieri, Farag, Breeding, Adier, Kasim, Rabinovitch, Breeding, Hayweerd, Priesiner, Ali and Husny during the period from 1913-1934. All species collected by the mentioned authors were identified by L. Masi. In addition to the previous field survey a literature review survey carried out including available insect reference collections in Egypt

(Plant Protection Research Institute Collections, Ain Shams Univ. Collection, Cairo Univ. Collection and Al-Azhar Univ. Collection) to determine *Brachymeria* hosts, monthly occurrence and geographical zone of species in Egypt.

2. *Pieris rapae* and *Brachymeria femorata* parasitoid :

An experimental area of 40 kirats located at Toukh Tanbisha village, Berkat El-Sabaa region, Monoufia Governorate was chosen during 2014 and 2015 cabbage (*Brassica oleracea var. capitata*) growing seasons as host plant. The whole area was divided into 4 replicates (10 kirats each). All replicates were planted with cabbage seedling. In the first season, sowing dates were February 3rd, May 1st, July 2nd and September 5th. In the 2nd season, the sowing dates were February 2nd, May 3rd, and September 5th. Sowing was carried out at intra-ridge spacing 70 cm on average, with an average of 10000 seedlings per feddan. All the recommended agricultural practices were followed, except any pesticide application. After 7 weeks of sowing date, the samples were collected weekly during the 8 weeks and 250 cabbage plants were chosen randomly represented one replicate was checked weekly. Last immature larval and healthy pupal stages of cabbage worm



Pieris rapae (Linnaeus) (Lepidoptera: Pieridae) was collected in cotton and kept in cloth bags which were closed with rubber bands and transferred to laboratory where the bags were put in small lb glass jars capacity covered with muslin cloth under laboratory conditions of $25 \pm 2^{\circ}\text{C}$ and $65 \pm 5\%$ R.H. The number of emerged parasitoids was recorded and tabled.

3. Spiny bollworm *Earias insulana* and *Brachymeria brevicornis* parasitoid:

The experimental area of this study was 12 kirats located at three districts; Ibnahs village, Qewaisna region, Monoufia Governorate, Qaha, Qalubiyah Governorate and Saft El Laban road, Giza Governorate cultivated with cotton during 2015 and 2016 (*Gossypium hirsutum*) growing seasons of host plant. The area 12 kirats was divided into 3 replicates and planted of cotton var. Giza 86. In the first and 2nd seasons, sowing dates were March 17th and 18th and the beginning of April. Cotton seeds were sown on one side of rows at 50 - 60 cm between rows and 15 cm between pits by placing 10 seeds in each pit at 4- 6 cm depth in soil. The normal recommended agricultural practices were followed, except for the absence of any pesticide application. Starting from the beginning of August and on 10 day intervals, a number of 25 fully grown bolls / karat were examined at the surface of the bottom of each boll and the healthy full-grown larvae of the spiny bollworm,

Earias insulana (Boisduval) (Lepidoptera: Nolidae) were collected and placed in test tubes which were stopper with pieces of cotton, then transferred to laboratory. Tubes were put in small lb glass jars capacity covered with muslin cloth under laboratory conditions ($25 \pm 2^{\circ}\text{C}$ and $65 \pm 5\%$ R.H.). The numbers of emerged parasitoids were counted, recorded and tabled at 24 hrs. Percentages of parasitism ratios were calculated according to the following formula:

$$\% \text{ of Parasitism} = \frac{\text{No. of emerged parasitoids}}{\text{Total no. of collected host insects}} \times 100.$$

The emerged parasitoids were prepared for microscopic inspection according to the following steps:

- a. Kill of parasitoid
- b. Conservation in alcohol 70% until the time of mounting.
- c. Boiling in NaOH 20%, using water bath for 5 to 20 minutes
- d. Washing in running water to get rid of NaOH.
- e. Dipping successively in different concentrations of alcohols from 30 %, 50%, 70%, 90%, 95 and 100% for 3-5 minutes in each concentration.
- f. Quick wash with xilon, then clove oil.
- g. Anatomy and preparation of slides by placing Canada balsam.
- h. Finally, use the oven at $40-60^{\circ}\text{C}$.
- i. Slides photos use light microscope.



Figure (2): Collected *Brachymeria* species by sweeping net.

Results and discussion

1. Field survey:

The field survey of *Brachymeria* wasps was carried out during the period from 2013-2018. The survey covered some Egyptian areas including different ecological zones. Data in Table (1) showed that the parasitoids collected by pupae and sweep net from Pomegranate, Cabbage, Olive, Cotton fields and the rabbits corpse during three successive seasons. The captured parasitoids were found belonging to 5 species which were identified as; *B. albicrus*, *B. femorata*, *B. minuta*, *B. aegyptiaca* and *B. brevicornis*. Most species were in September. *B. femorata*, *B. aegyptiaca*, *B. minuta* and *B. brevicornis*, respectively were the most widely distributed species in terms of number of localities, While *Brachymeria* was not captured the Light trap. Data in Table (2) and Figure (3) showed that 12 species were collected belonging to of *Brachymeria* distributed in Egypt. included 176 specimens was the most representative number of species collected. In similar studies, Kamal (1937) pointed out that *B. femorata* (Panzer) is widely distributed at various localities of Lower Egypt, and he was astonished about the aestivation of this insect. Gray and Treloar (1933) carried out a detailed study in order to show how many sweeps are necessary to afford a real able index of the population density. Noyes (1982) showed the ways for the ways for collecting and preserving chalcid wasps. The author discussed that the most profitable ways for collecting chalcids, those included sweeping, pitfall traps and extraction from leaf litter or grass tussocks. The techniques of sweeping, card mounting specimens and slide preparation are described in detail. Zhao *et al.* (1986) surveyed the natural enemies of the crucifer pest (*Pieris rapae*

L.) in China. They found seven parasitic species (*T. evanescens*, *Apanteles rubecula*, *Apanteles glomeratus*, *Hyposter* sp., *Mermis* sp., *Pteromalus puparum* and *B. femorata*). Moursy *et al.* (1996) reported that most species of *Brachymeria* are parasitoids on larvae and pupae of Diptera, Coleoptera and Lepidoptera. Rasmi *et al.* (2011) surveyed the parasitoid species that were found attacking larvae and pupae of *Pieris brassicae* (L.) (Lepidoptera: Pieridae) in the *Brassica* agro-ecosystem in the Urmia region, northwest of Iran, between 2008 and 2009. Parasitized hosts were collected from infested plants placed in *Brassica* crops during the growing season (June-October), and from the natural *P. brassicae* population on the common weeds *Capparis spinosa* L. (Capparaceae) *Crambe orientalis* L. and *Raphanus raphanistrum* L. (Brassicaceae) during the summer production break (December). Ten hymenopterous species of primary parasitoids – *Cotesia glomerata* (L.) (Braconidae), *Brachymeria femorata* Panzer (Chalcididae), *Aprostocetus taxi* Graham (Eulophidae), *Agrothereutes adustus* Grav., *Blapsidotes vicinus* Grav., *Hyposoter clauses* Brischke (Ichneumonidae), *Pteromalus puparum* (L.) (Pteromalidae) and three dipterous species *Exorista larvarum* (L.), *Exorista segregata* Rondan, *Phryxe vulgaris* Fallén (Dip.: Tachinidae) were identified. Sarcophagidae, Calliphoridae, *Tachinid puparia*, Muscidae, Trypetidae, Psychidae, Yponomeutidae. and Lymantriidae Zhao *et al.* (1986) surveyed the natural enemies of the crucifer pest (*Pieris rapae* L.) in China. They found seven natural enemies (*T. evanescens*, *Apanteles rubecula*, *Apanteles glomeratus*, *Hyposter* sp., *Mermis* sp., *Pteromalus puparum* and *Brachymeria*

fermata. Narendran and Rao (1987) showed that Chalcididae hosts belong to Lepidoptera, Diptera, Hymenoptera, Neuroptera, Coleoptera and Strepsiptera.). Andriescu (1988) recorded that *B. femorata* was a frequent parasite of *Aporia crataegi* and mention the parasitization of pupae of *Cassida* by *B. inermis*, of pupae of *Mamestra suasa* and *Aphelia vibumana* by *B. intermedia*, and of puparia of Tabanidae and *Musca domestica* by *B. minuta*. Moursy *et al.* (1996) remember that the most species of *Brachymeria* were parasites on larvae and pupae of Diptera, Coleoptera and Lepidoptera. Shaw *et al.* (2009) showed a few species of *Brachymeria* were solitary primary parasitoids of Lepidoptera pupae, and attacked butterflies in grassland habitats regularly. *B. femorata* (Panzer) separated from pupae of *Pieris brassicae*, *Melitaea didyma*, *M. deione* and *Maniola jurtina*; On other hand *B. tibialis* (Walker) get from *Euphydryas aurinia* and *E. desfontainii*. Maosheng (2015) observed that *Brachymeria* sp. ovipositing on a Calliphoridae and Sarcophagidae larvae on the rotting carcass of The young brahminy kite (*Haliastur indus*) in Singapore Island. Chakraborty *et al.* (2015) Illustrate that endoparasitoids: *B. minuta* (Hymenoptera: Chalcididae) in forensic indicator *Sarcophaga (Parasarcophaga) albiceps*. Hasanshahi *et al.* (2013) recorded that *B. albicrus* (Klug) (Hymenoptera: Chalcididae) a pupal parasitoid of the cabbage white butterfly, *Pieris rapae* (Linnaeus, 1758) from Iran. Roberts (1933) decided that *B. fonscolombei* (Dufour) a hymenopterous parasite of blowfly larvae, on (*Sarcophaga plinlhopyga*) Wied, *Phormia regina* Meig, *Lucilia unicolor* Towns, *Calliphora coloradensis*,

Synthesiomyia nudiseta, *Lucilia sericata* Meig and *Cochliomyia macellaria*.

2.Economic importance of *Brachymeria* species in Egypt:

Data presented in Table (3) are concerned with *Brachymeria* species which attack pests belonging to various insect Orders ; Lepidoptera and Diptera .The highest number of *Brachymeria* are species recorded on order Lepidoptera, where the number reached 10 species that attacked more than one host species . Hosts from Order Lipdoptera included 7 families (Lycaenidae, Pieridae, Nymphalidae, Nolidae, Noctuidae, Pyralidae and Lymantriidae). The Order Diptera came the second as hosts of the *Brachymeria* species. Dipterous hosts included 7 species belonging to 3 families (Calliphoridae, Muscidae and Sarcophagidae). The parasitoid *B. minuta* (Linn.) was very close resemblance with *B. fonscolombei* in hosts. These results were in agree with Thompson (1954) who reported *Brachymeria* as one of hymenopterous parasitoids that attacked some insect species belong to Orders Lepidoptera, Diptera and Hymenoptera . In Egypt *B. brevicornis* Klug was attacks *Earias insulana* Boisd. (Lep. Arctiidae). Ferriere and Kerrich (1958) indicated that *Brachymeria* species are parasitoid emerging from pupae, more often of Lepidoptera or Diptera, but sometimes from Hymenoptera or Coleoptera. Leonard (1966) mentioned that *B. intermedia* (Nees) was established in North America. *B. intermedia* was a parasitoid on *Porthetria dispar* and other lepidopteran pupae in Southern Europe and northern Africa. Joseph *et al.* (1973) recorded that *B. minuta*, *B. fonscolombei*, *B. femorata*, *B. excarinata* hosts belonging to the Pieridae (*P. rapae*).

3. Geographic distribution of *Brachymeria* species in Egypt:

Data show in Tables (4 and 5) and Figure (4) that the most *Brachymeria* spp. appears to have a strictly or mainly Lower of Egypt, it represented in the following Governorates, Giza , Helwan, Sharqia, Qalyubia , Dakahlia , Kafr El Sheikh, Gharbia, Monoufia and Ismailia respectively. From the few specimens available these species appear in Upper Egypt (Qena, Bahariya Oasis, Aswan) and Costal stripes (Beheira, Mersa Matruh, Red Sea) distribution. It is probable that its distribution may extend to desert areas near the newly reclaimed agriculture in Egypt. The only species was recorded with slightly number in Sinai from near the coast is *B. aegyptiaca*. on the other hand, *B. minuta* , *B. brevicornis* , *B. fonscolombei* , *B. femorata* , *B. albicrus*, and *B.aegyptiaca* more monthly present or more adapted to the Egyptian environment .In the same context *B. minuta* , *B. fonscolombei* , *B. aegyptiaca* ,*B. femorata* , *B. albicrus*, *B. excarinata*, *B. kassalensis* , *B. vicina* and *B. somalica* were worldwide distribution other than *B. brevicornis* and *B. ancilla*. These results agreed by Masi (1929a) who studied on the genus *Brachymeria* West., from the Ethiopian. region, species *B. leighi* (Cam.), *B. feae*, *B. bottegi*, *B. cowani*, *B. magrettii*, *B. paolii*, *B. somalica*, *B. bayoni*, *B. afra*, *B. spilopus*, *B. dumbrodyensis* (Cam.), *B. capensis* and *B. beccarii*. Roberts (1933) showed that *B. fonscolombei* was generally distributed over central Europe, extending into Russia and Asia. Specimens collected from Batavia, Java, and deposited in the National Museum of United States in North America. Also, it had been found throughout the southern part (Florida to California and as far north as Illinois). The previous specimens

are known in Mexico and Haiti. Kamal (1937) pointed out that *B. femorata* (Panzer) was widely distributed at various localities of Lower Egypt, and he was astonished about the aestivation of this insect. Leonard (1966) mentioned that *B. intermedia* (Nees) (Hymenoptera: Chalcididae) established in north America. Also *B. intermedia* was a parasite of *Porthetria dispar* and other lepidopteran pupae in southern Europe and northern Africa. Habu (1960) explained the distribution of *B. minuta*, *B. fonscolombei*, *B. femorata* and *B. excarinata* distribution in Japan. Joseph *et al.* (1973) explained the oriental species of *Brachymeria*: *B. minuta*, *B. fonscolombei*, *B. femorata*, *B. excarinata* distribution in India, Japan, Korea, Manchuria, North China (Mongolia, Siberia, Formosa, Botel-tobaco Is.) Central Asia, Asia Minor, Europe, North Africa. Vietnam, Philippines, Java, Cambodia, B.N. Borneo. North America and Thailand. Karrom (1974) mentioned *B. minuta* and *B. vicina* distribution in Syria. Klincer (1982) studied the field populations of the parasite complex associated with *Artogeia rapae* (L.) (*Pieris rapae*) on cabbage in Turkey and reared these parasites in the laboratory. *Trichogramma evanescens* west, was the only egg parasite. *Apanteles glomeratus* (L.) and *Pteromalus puparum* (L.) parasitized the larvae. On the other hand, *Pteromalus puparum* (L.) and *B. femorata* (Panz.) were the pupae parasites. Zhao *et al.* (1986) surveyed the natural enemies of the crucifer pest (*Pieris rapae* L.) in China. They found seven natural enemies (*T. evanescens*, *Apanteles rubecula*, *Apanteles glomeratus*, *Hyposter* sp., *Mermis* sp., *Pteromalus puparum* and *B. femorata*). El-Moursy *et al.* (1996) pointed that most species of *Brachymeria* are

distribution in Lower Nile and parasites on larvae and pupae of Diptera, Coleoptera and Lepidoptera. Andriescu (1988) studied the faunistic, biogeographical and economic of family chalcididae in Rumania, the most abundant and frequent species were *Chalcis sispes*, *B. minuta*, and *B. intermedia*, however the rarest were *Neochalcis fertoni*, *Lasiochalcidia guineensis*, *Invrea subaenea* and *I. mirabilis*. Hasanshahi *et al.* (2013) studied new record of *B. albicrus* (Klug) (Hymenoptera: Chalcididae) a pupal parasitoid of the cabbage white butterfly, *P. rapae* from Iran.

4. Seasonal abundance of *Brachymeria brevicornis* parasitoids of in different crops and locations during 2015 and 2016 on cotton growing seasons:

Data present in Table (6) and Figures (5 and 7) show that the highest mean parasitism percentage was recorded at Qaha , Qalyubia Governorate, sowing during 2015 cotton growing seasons (4.76%) followed by Saft El Laban road , Giza Governorate, sowing during 2016 on cotton growing seasons (4.47%). While the ratio was almost halved at Qaha ,2016 to become (2.38%) and exceeded half at Saft El Laban road, Giza Governorate, sowing during 2015 was (2.85%); There was no recorded percentage of *B. brevicornis* Klug parasitism in Menoufia governorate. although the largest population of *B. brevicornis* insects was in Giza Governorate, sowing during 2015 and 2016 by four insects followed by Qaha, 2015 and 2016 by 3 insects. These results agreed with Thompson (1954), he mentioned that *Brachymeria* was one of hymenopterous parasitoids that attacking some insects on some families specially orders Lepidoptera. In Egypt *B. brevicornis* attaching *E. insulana*.

5. Seasonal abundance of *Brachymeria femorata* parasitoid of *Pieris rapae* in different locations during 2014 and 2015 cabbage growing seasons:

The data which presented in Table (7) and Figures (6 and 8) show *B. femorata* .The highest mean parasitism percentage was recorded at sowing during September 2014 and 2015 cabbage growing seasons (28.49% in 2014) and (24.46 % in 2015), respectively , followed by the mean percentages of parasitism sowing during July 23.95 and 17.28% respectively , followed by the mean percentages of parasitism sowing during May 10.18% and 3.23% respectively. The mean percentages of parasitism sowing during February 2014 and 2015 were 0.00. Finally, the solitary parasitoid *B. femorata* was recorded in *P. rapae* pupae at the. numbers of the mentioned parasitoid along the months of Late December to June, while it was found at the rest months (July to beginning of December). The highest parasitism percentage were recorded at September, October and November compared with other months. The highest mean parasitism percentage were recorded at 2014 specially during November compared with 2015 year. These results agree with Kamal (1937) pointed out that *B. femorata* (Panzer) allied ones are extremely important as natural agents of control on some of our most important crop pests and seem to survive very well under the mild climate of this country. Hu in China (1983) carried a survey during (1978-1972) on the pest *Artogeia rapae* (L.) and found *Apanteles glomeratus* (L.), *Pteromalus puparum* (L.) and *B. femorata* (Panz.) species as primary parasites with (0-64.5% and 0-97%) parasitism percentage of larvae and pupae , respectively . Hussain *et al.*

(1992) indicated that *B. femorata* and *Pteromalus puparum* are founded to be effective in controlling *Pieris rapae* (L.) in Egypt. Parasitoids were found in crucifer fields parasitizing the pupal stage at 2 distinct periods: the 1st extended from October to mid – January and the 2nd from March to April. The percentage of parasitism by *B. femorata* and *P. puparum* ranged from 13.7 to 20.7%, respectively. Youssef and Moursi (1988) mentioned that, a field experiment was conducted in Alexandria, Egypt, to determine the natural mortality factors affecting *Pieris rapae* population in cabbage fields. The results showed that parasitism by *P. puparum* and *B. femorata* was the major mortality factor, causing up to 83.7 and 10.9 % mortality of larvae and pupae, respectively. Karrom (1974) pointed out the seasonal abundance of the Chalcidids which were mainly endoparasites in other insects, depended on the both seasonal abundance of these hosts and their life cycles.

Many species of this genus spread in different places in Egypt and were

mostly primary parasitoids in pupae of holometabolous insects, especially of Lepidoptera, but some species attack Diptera, which contain many of the pests that were harmful to humans, Therefore the precise determination species concerned is highly important in any host –parasite study for biological control. Most of the species *Brachymeria* wasps of found in Egypt are concentrated in the agricultural areas, especially the Nile Delta region and around it. Most of them were recorded from the Palearctic region. Some wasps of the genus *Brachymeria* were primary parasitoids of butterfly from the families Pieridae and Nolidae, More than one egg may be inserted into a single maggot by the female wasp. The wasp larvae feed on the maggot from the inside, but only one adult wasp will emerge when the host dies. *B. femorata* and *B. brevicornis* species as well as its allied ones were extremely important as natural agents of control on some important vegetables and crop pest and it survived very well under the mild climate in Egypt.

Table (1): Field survey of *Brachymeria* species in Egypt (2013-2018).

Species	Date	Year	Locality	Plant	Remarks
<i>B. aegyptiaca</i>	September, October and November	2014 ,2015 ,2016 and 2017	Cairo - Alexandria Desert Road, Wadi al-Arish, and Kom Oshim	Olive and Pomegranate	by sweeping and from pupae
<i>B. albicrus</i>	September	2014	Cairo - Alexandria Desert Road	Pomegranate	from pupae
<i>B. brevicornis</i>	August and September	2015, 2016	Qaha and Saft El Laban Road	Cotton	from pupae
<i>B. femorata</i>	July, August, September, October and November	2013, 2014 ,2015 ,2016 and 2017	Kom Halin, TokhTanabsha, Kafr Alaym, Berkat as Sabee, Shibin El Kom, Quesna, Qaha, Mansoura, Habbes valley, Sidi Salem, Kotor and Damanhur.	Cabbage	by sweeping and from pupae
<i>B. minuta</i>	March and April	2014	Cairo and zigazig	The rabbit's corpse	from pupae

Table (2): Numbers or population number of *Brachymeria* species in Egyptian Collections.

Collections Species	Ministry of Agriculture	Ain Shams University, Department of Entomology	Alfieri	Society of Entomology in Cairo	Total	State
<i>B. aegyptiaca</i>	18	0	1	0	19	Moderate
<i>B. albicrus</i>	4	5	0	0	9	Moderate
<i>B. ancilla</i>	3	0	0	0	3	Rare
<i>B. brevicornis</i>	25	1	1	0	27	Common
<i>B. excarinata</i>	2	0	0	0	2	Rare
<i>B. femorata</i>	48	2	0	0	50	Common
<i>B. fonscolombei</i>	5	1	0	0	6	Moderate
<i>B. kassalensis</i>	2	0	0	0	2	Rare
<i>B. libyca</i>	1	0	0	0	1	Rare
<i>B. minuta</i>	71	16	11	4	102	Common
<i>B. somalica</i>	4	0	0	0	4	Moderate
<i>B. vicina</i>	2	0	0	0	2	Rare
Total	185	25	13	4	227	

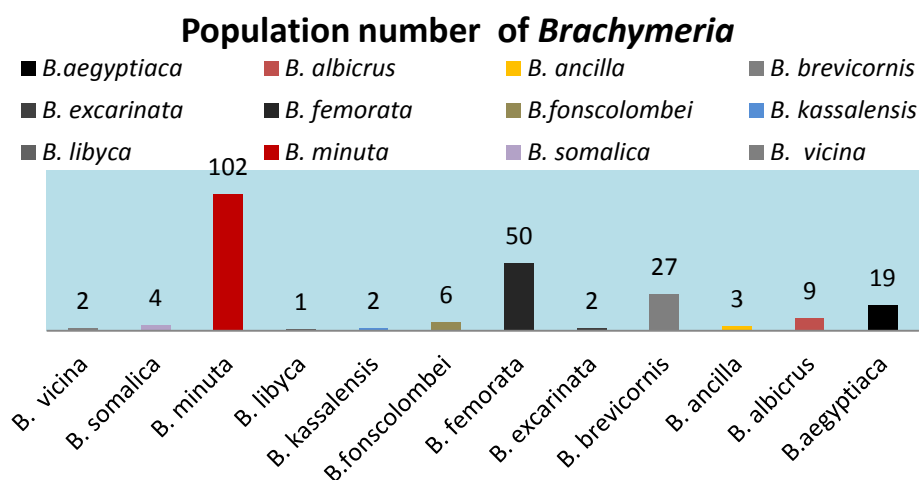


Figure (3): Population number of *Brachymeria* species in Egyptian collections.

Table (3): Economic importance of *Brachymeria* species in Egypt.

<i>Brachymeria</i> species	Host insect species record		
	Species	Family	Order
<i>B. aegyptiaca</i>	<i>Virachola livia</i>	Lycanidae	Lepidoptera
	<i>Palpita unionalis</i>	Pyrilidae	
<i>B. albicrus</i>	<i>Danais chrysippus</i>	Nymphalidae	
	<i>B. brevicornis</i>	<i>Earias insulana</i>	
<i>Virachola livia</i>		Lycanidae	
<i>B. excarinata</i>	<i>Spodoptera litura</i>	Noctuidae	
<i>B. femorata</i>	<i>Pieris rapae</i>	Pieridae	
<i>B. fonscolombei</i>	<i>Lucilia sericata</i> , <i>Chrysomya albiceps</i> and <i>Synthesiomyia nudiseta</i>	Calliphoridae and Muscidae	Diptera
<i>B. kassalensis</i>	<i>Chaerocampa elpenor</i>	Sphingidae	Lepidoptera
<i>B. libyca</i>	<i>Wohlfahrtia argentifrons</i>	Sarcophagidae	Diptera
		Calliphoridae	
<i>B. minuta</i>	<i>Sarcophaga hertipes</i>	Sarcophagidae	
	<i>Snout moths</i>	Pyrilidae	Lepidoptera
<i>B. vicina</i>	<i>Lucilia sp</i>	Calliphoridae	Diptera
	<i>Porthetria dispar</i>	Lymantriidae	Lepidoptera

Table (4): Monthly occurrence and geographical zone of *Brachymeria* species in Egypt.

Species	Months												Geographical Zone
	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	oct.	Nov.	Dec.	
<i>B. aegyptiaca</i>	-	-	-	-	-	-	-	-	+	+	++	+	Costal stripes, Lower Egypt and Sinai
<i>B. albicrus</i>	-	-	-	-	-	-	+	-	+	+	+	++	Lower Egypt and Upper Egypt
<i>B. ancilla</i>	-	-	-	-	-	-	-	-	-	+	-	-	Lower Egypt
<i>B. brevicornis</i>	-	-	+	+	+	+	+	++	+	+	-	-	Costal stripes, Lower Egypt and Upper Egypt
<i>B. excarinata</i>	-	-	-	-	-	-	-	-	+	-	-	-	Lower Egypt
<i>B. femorata</i>	-	-	+	-	-	-	++	+	++	+++	++	+	Costal stripes and Lower Egypt
<i>B. fonscolombei</i>	-	-	-	+	+	+	+	+	+	+	+	-	Lower Egypt
<i>B. kassalensis</i>	-	+	-	-	-	-	-	-	-	-	-	-	Upper Egypt
<i>B. libyca</i>	-	-	-	-	-	+	-	-	-	-	-	-	Lower Egypt
<i>B. minuta</i>	-	-	+	++	++	++	+	+	++	+++	+++	++	Costal stripes, Lower Egypt and Upper Egypt
<i>B. somalica</i>	-	-	-	-	-	-	-	-	-	+	+	+	Lower Egypt
<i>B. vicina</i>	-	-	-	-	-	-	-	-	-	+	-	-	Lower Egypt

*(-) indicate to specimens lack (+) indicates to the increase in specimens within the species.

Table (5): Distribution of *Brachymeria* species in Egyptian Governorates.

Governorate	Species											
	<i>B. albicrus</i>	<i>B. excarinata</i>	<i>B. femorata</i>	<i>B. minuta</i>	<i>B. ancilla</i>	<i>B. fonscolombei</i>	<i>B. kassalensis</i>	<i>B. somalica</i>	<i>B. aegyptiaca</i>	<i>B. vicina</i>	<i>B. brevicornis</i>	
Dakahlia			+						+			
Sharqia			+	+					+			
Qalyubia			+	+							+	
Kafr El Sheikh			+	+								
Gharbia			+									
Monoufia			+									
Beheira	+		+	+					+		+	
Ismailia				+								
Helwan		+		+		+		+				
Giza			+	+	+			+	+	+	+	
Qena											+	
Sinai									+			
Bahariya Oasis				+								
Red Sea							+					
Aswan	+											
Mersa Matruh			+	+		+						

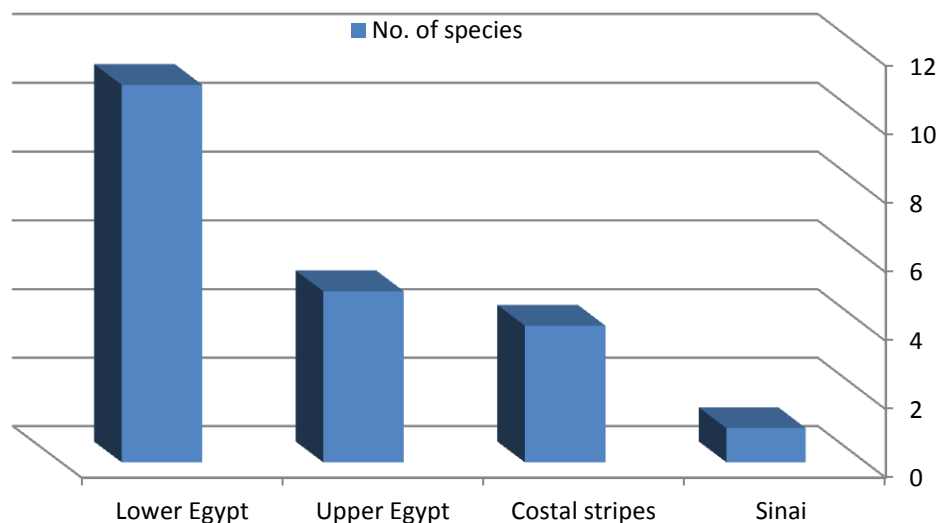


Figure (4): Number of *Brachymeria* species and geographical zone in Egypt.

Table (6): The percentage of *Brachymeria brevicornis* parasitism in spiny bollworm *Earias insulana* pupae, sowing during 2015 and 2016 cotton growing seasons.

Date and Governorates	2015			2016		
	Monoufia	Qalyubia	Giza	Monoufia	Qalyubia	Giza
1 August	0	0	0	0	0	0
11 August	0	0	0	0	0	0
21 August	0	0	0	0	0	9.09
31 August	0	0	20	0	16.66	22.22
10 September	0	33.33	0	0	0	0
20 September	0	0	0	0	0	0
30 September	0	0	0	0	0	0
Mean		4.761429	2.85714		2.38	4.47285

Table (7): The percentage of *B. femorata* (Panz.) parasitism in *Pieris rapae* pupae at the Toukh Tanbisha village, Berkat El-Sabaa region, Monoufia Governorate sowing during 2014 and 2015 cabbage growing seasons.

Sawing date	2014			2015		
	February	May	July	February	May	July
7 Weeks	0	30	33.33	0	9.09	50.00
8 Weeks	0	0	50.00	0	0	33.33
9 Weeks	0	12.5	11.11	0	0	0
10 Weeks	0	11.11	14.28	0	0	20
11 Weeks	0	0	12.5	0	20	0
12 Weeks	0	12.5	28.57	0	0	20
13 Weeks	0	25.55	20	0	0	0
14 Weeks	0	0	33.33	0	0	22.22
15 Weeks	0	0	12.5	0	0	10
Mean		10.18444	23.95778		3.232	17.28333

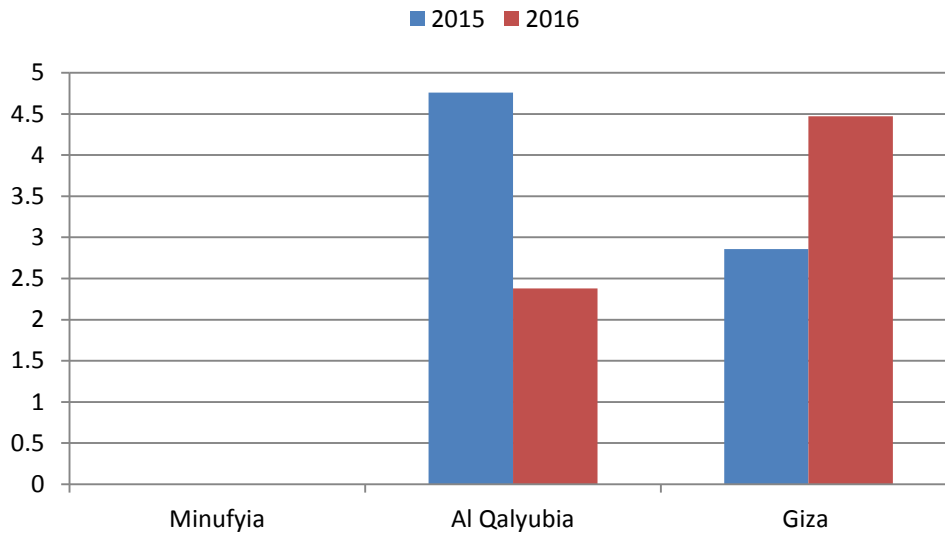


Figure (5): Percentage of *Brachymeria brevicornis* parasitism in spiny bollworm *Earias insulana* pupae, sowing during 2015 and 2016 cotton growing seasons.

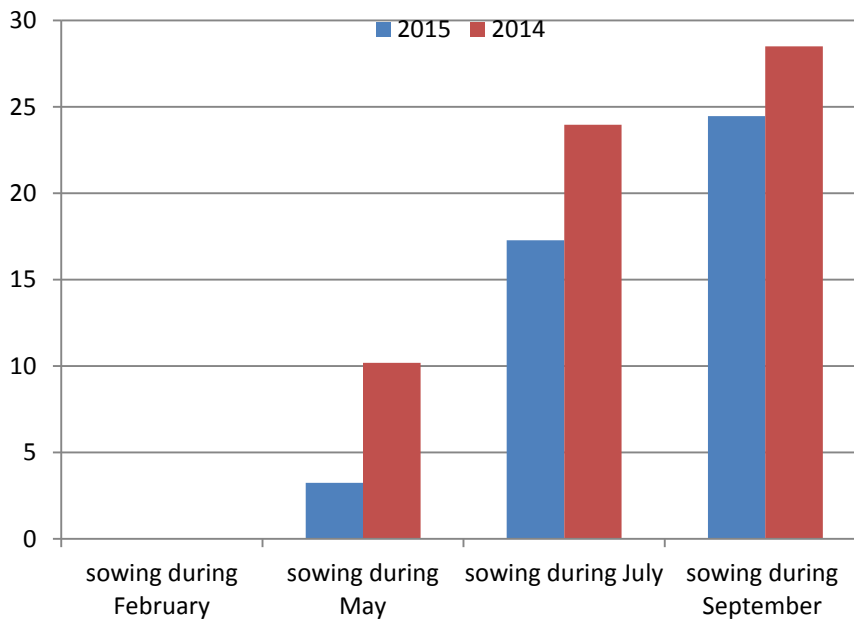


Figure (6): Percentage of *Brachymeria femorata* parasitism in *Pieris rapae* pupae at the Toukh Tanbisha village, Berkat El-Sabaa region, Monoufia Governorate.

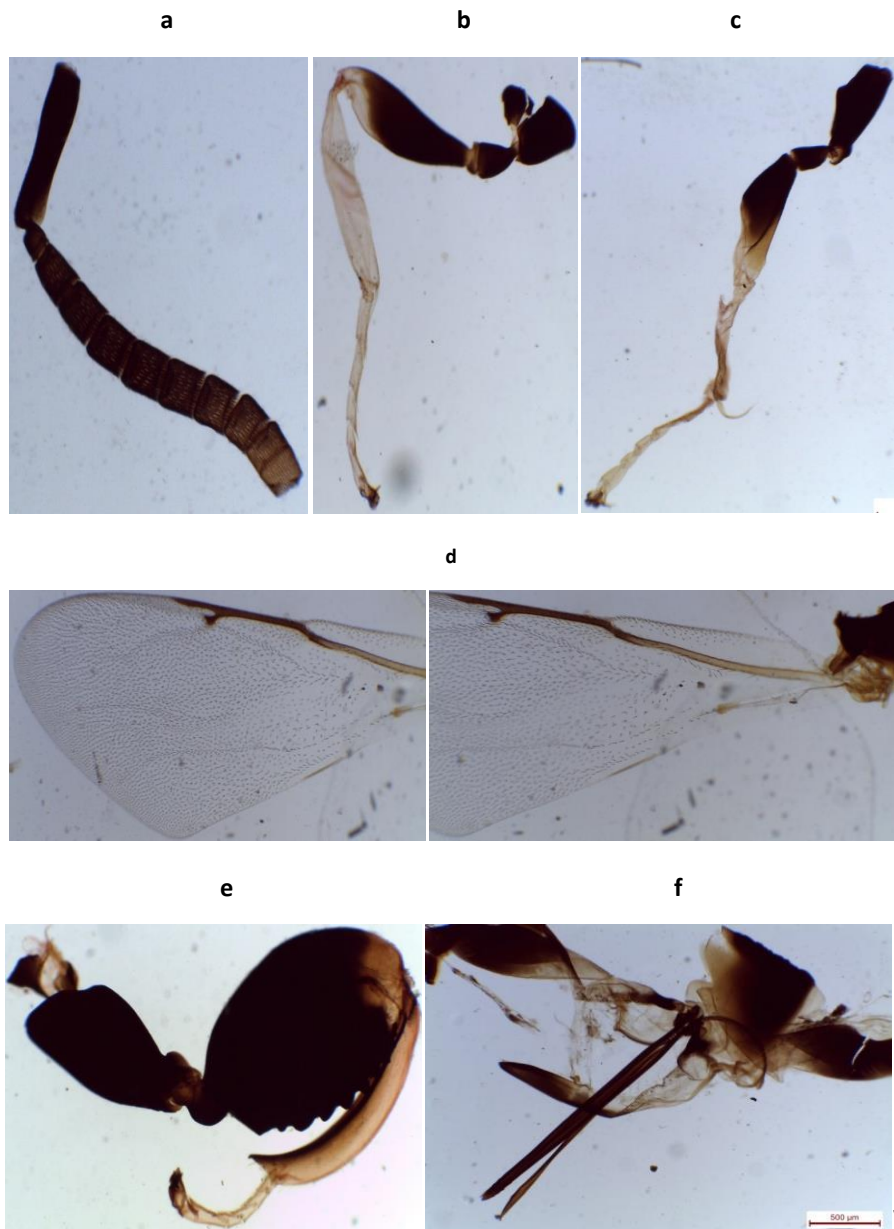
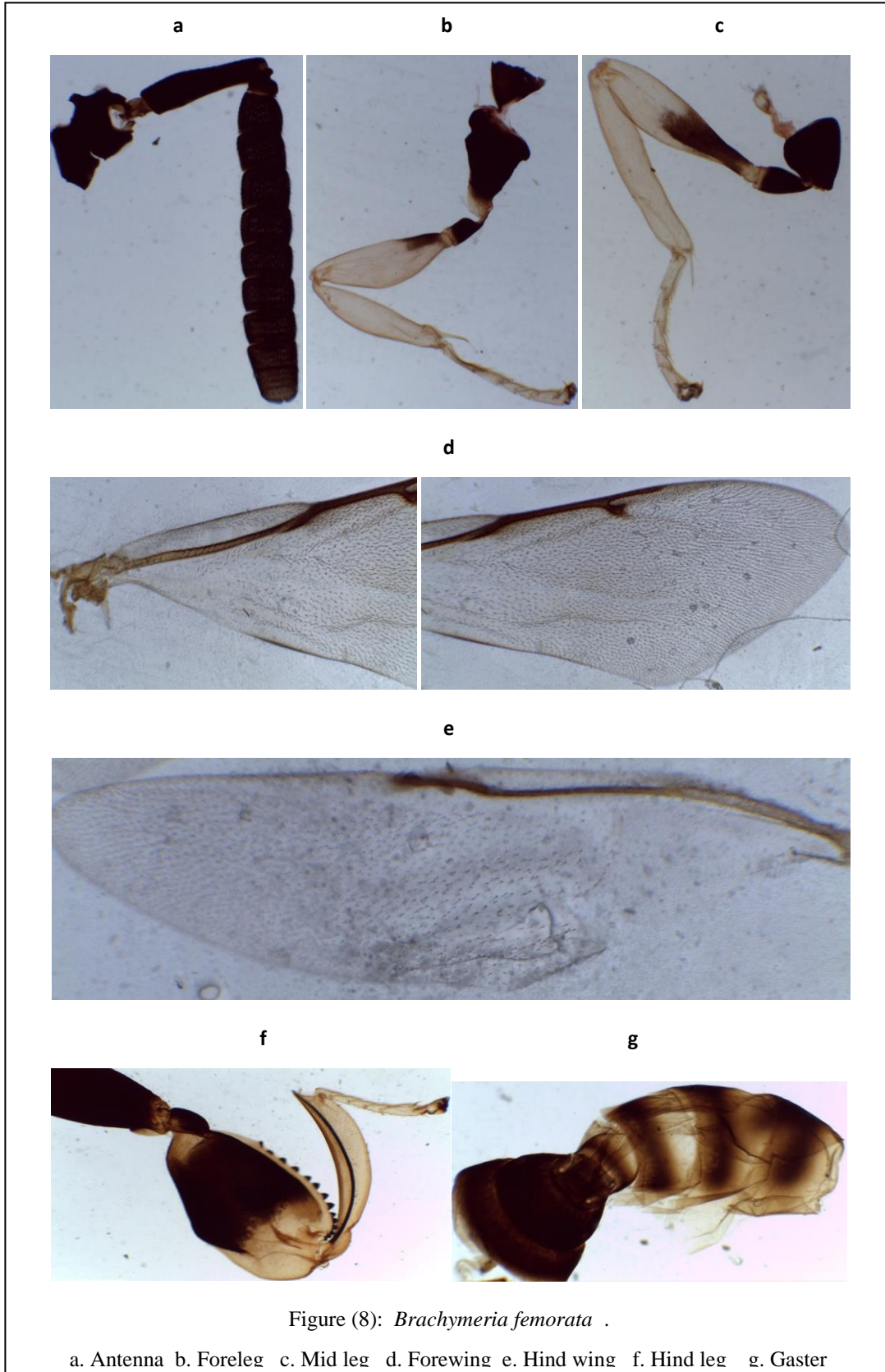


Figure (7): *Brachymeria bravicornis* .

a. Antenna b. Foreleg c. Mid leg d. Forewing e. Hindleg f. Ovipositor sheath



Reference

- Agusti, N.; Bourguet, D.; Spataro, T.; Delos, M.; Eychenne, N.; Folcher, L. and Arditi, R. (2005):** Detection, identification and geographical distribution of European corn borer larval parasitoids using molecular markers. *Mol. Ecol.*, 14: 3267–3274.
- Andriescu, I. (1988):** The family Chalcididae in Rumania, a faunistic, biogeographical and economic study. *Advances in Parasitic Hymenoptera Research*, 259-263.
- Bouček, Z. (1952):** The first revision of the European species of the family Chalcididae (Hymenoptera). *Sborník Entomologického Oddeleni Národního Musea v Praze* 27 (supplement 1) pp. 1-108.
- Bouček, Z. (1956):** A contribution to the knowledge of the Chalcididae, Leucospidae and Eucharitidae (Hymenoptera, Chalcidoidea) of the Near East. *Bulletin of the Research Council of Israel*, 5B: 227-259.
- Bouček, Z. (1988):** Australasian Chalcidoidea (Hymenoptera). A biosystematic revision of genera of fourteen families, with a reclassification of species. 832pp. CAB International, Wallingford, Oxon, U.K., Cambrian News Ltd; Aberystwyth, Wales.
- Chakraborty, A.; Ghosh, S.; Ansar, W. and Banerjee, D. (2015):** Thermophilic Pupal Endoparasitoids: *Brachymeria minuta* (Hymenoptera: Chalcididae) on forensic indicator *Sarcophaga* (*Parasarcophaga*) *albiceps*. *Prommalia*, 3: 85-94.
- El-Moursy, A. A.; Mohamed, S. K. and Gadalla, N. S. (1996):** Biological Diversity of Egypt (Insecta). pp. XI-XII and 46-50, United National Environment Program, Part VII.
- Ferrierre, Ch. and Kerrich, G. J. (1958):** Handbooks for the Identification of British Insects (Hymenoptera: Chalcidoidea) Vol. VIII, Part 2 (a). pp. 1-40, Published by the Royal Entomological Society of London.
- Godfray, H.C.J. (1994):** Parasitoids: Behavioural and Evolutionary Ecology. Princeton University Press, Princeton.
- Gray, H.E and Traloar, A.E. (1933):** On the enumeration of insect populations by the method of net collection ecology, 14(4):356-367.
- Habu, A. (1960):** A revision of the Chalcididae (Hymenoptera) of Japan with description of sixteen new species. *Bull. Nat. Inst. Agric. Sci. Tokyo, Ser. (C)*, 11: 131-363.
- Hasanshahi, G.; Jahan, F. ; Abbasipour, H. and Escolà, A. R. (2013):** New record of *Brachymeria albicrus* (Klug) (Hymenoptera: Chalcididae) a pupal parasitoid of the cabbage white butterfly, *Pieris rapae* (Linnaeus, 1758) from Iran. *J. Bio.Control*, 27(2): 124-125.
- Hu, C. (1983):** A survey of the parasites of the small white better fly, *Artogeia rapae* (L.) in China. *Acta Entomologica Sinica*, 26(3): 287-294.
- Hussain, A. E.; Ali, M. A.; Metwally, M.M.; Hegab, M.F.A.H. and**

- Kamel, M. H. (1992):** Seasonal occurrence of *Pieris rapae* L., pupal parasites and their importance as biological control agent, Egyptian Journal of Agricultural research, 70 (1) :197-206.
- Joseph, K. J.; Narendran, T.C. and Joy, P. J. (ed.) (1973):** Oriental *Brachymeria*: Amonograph on the Oriental Species of *Brachymeria* (Hymenoptera: Chalcididae). University of Calicut, Zoology Monograph, no 1: vii+ 215 pp, Published by Dr. K. J. Joseph, Xavier Press, Calicut, India.
- Kamal, M. (1937):** *Brachymeria femorta* (Panz.) (Hymenoptera: Chalcididae) a primary parasite of the cabbage worm *Pieris rapae* L. Bull. Soc. Roy. Ent. Egypt, 21: 5-27.
- Karrom, M. A. (1974):** Survey and taxonomy of family Chalcididae (Hymenoptera) from A.R. Egypt and Syrian A.R. Msc., Ain Shams University.
- Klincer, N. (1982):** Investigation on the parasite complex of the small cabbage white butterfly (*Pieris rapae* L.) lep.: Pieridae in the Ankara Region. Bitki-Koruma Bulteni, 22(3): 107-119.
- Leonard, D. E. (1966):** *Brachymeria intermedia* (Nees) (Hymenoptera: Chalcididae) established in north America. Entomological News, Vol. LXXVII,1:25-27.
- Maosheng, F. (2015):** Parasitoid wasp *Brachymeria* sp. ovipositing on a dipteran larva. Singapore Biodiversity Records: 66.
- Masi, L. (1929a):** Contributo alla conoscenza delle species etiopichedi *Brachymeria* (Gen. C halcis auct.). Memorie della Società Entomologica Italiana, 8: 114-144
- Masi, L. (1929b):** Contributo alla conoscenza dei calcididi orientali della sottofamiglia Chalcidinae. Bollettino del Laboratorio di Entomologia del R. Istituto Superiore Agrario di Bologna, 2:167-185.
- Masi, L. (1936):** On some Chalcidinae from Japan (Hymenoptera, Chalcididae). Mushi, 9:47-51.
- Narendran, T. C. and van Achterberg, C. (2016):** Revision of the family Chalcididae (Hymenoptera, Chalcidoidea) from Vietnam, with the description of 13 new species. ZooKeys, 576: 1–202.
- Narendran, T.C. and Rao, S. A. (1987):** Biosystematics of Chalcididae (Chalcidoidea: Hymenoptera). Proc. Indian Acad. Sci. (Anim. Sci.), 96 (5): 543 – 550.
- Nikol'skaya, M. (1952):** the Chalcids fauna of the USSR (Chalcidoidea). Opredeliteli po Faune SSSR 44:91-101 Zoologicheskim Institutom Akademii Nauk SSSR, Moscow and Leningrad.
- Noyes, J. S. (1982):** Collecting and preserving chalcid wasps (Hymenoptera: Chalcidoidea). Journal of National History ,16: 315 - 334.
- Noyes, J. S. (2011):** Universal Chalcidoidea Database. <http://www.nhm.ac.uk/chalcidoids> .
- Razmi, M.; Karimpour, Y.; Safaralizadeh, M. H. and Safavi, S.A. (2011):** Parasitoid complex of cabbage large white butterfly *Pieris brassicae* (L.) (Lepidoptera, Pieridae) in Urmia with new records from Iran. J.

- Plant Protection Res., 51 (3): 248-251.
- Roberts, R. A. (1933):** Biology of *Brachymeria fonscolombei* (Dufour). A Hymenopterous parasite of Blowfly larvae. Tech. Bull. U.S. Dept. Agr., No. 265: 1-21.
- Shaw, M. R.; Stefanescu, C. and Nouhuys, S. V. (2009):** Parasitoids of European butterflies. In (J. Settele, T. Shreeve, M. Konvicka and H. van Dyck. (Ed.) ,130-156.
- Steffan, J. R. (1959):** les especes Francaise du genre *Brachymeria* (Westw.) Cahier Des Natural lists, Bull., 15: 35-44.
- Thompson, W.R. (1954):** A catalogue of the Parasites and Predators of Insect Pests: Hosts of the Hymenoptera (Calliceratid to Evaniid). Commonwealth Institute of Biological Control. Ottawa, Ont., Canada. pp. 191 - 331.
- Youssef, K.H. and Moursi, K.S. (1988):** Some factors controlling white cabbage butterfly. Agricultural Research Review, 66(1):91-95.
- Zhao, H.Y.; Wan, L.M.; Zhang, W.L. and Pei, D.J. (1986):** A survey of the natural enemy resource of *Pieris* in Tung. Hau, Jilin. Chinese Journal of Biological Control, 2(1):42.