

**Redescription of two Species of Ladybird Beetles (Coccinellidae: Coleoptera)**

 Research Project

Submitted to the department of plant protection in partial fulfillment of the requirement for the degree of BSc in Plant Protection

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**CERTIFICATE**

This research project has been written under my supervision and has been submitted for the award of the **BSc.** degree in **Agricultural Sciences – Plant Protection** with my approval as a supervisor.

Signature

Name: Asst. Lecturer Hero Muhyaddin Muhammad

Date:

**DEDICATION**

“Keep your dreams alive. Understand to achieve anything requires faith and belief in yourself, vision, hard work, determination, and dedication. Remember all things are possible for those who believe”

This effort I dedicate to **Allah** Almighty, my lord, my powerful foundation, my source of inspiration, wisdom, knowledge, and understanding. Throughout this project, he was the source of my energy.

 Abdulla

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To begin with, I thank (Allah) for His blessing, which made me able to complete and perform this study with success, the lord of the universe, blessing, and peace be on Muhammad (Allah’s peace and prayers be upon him).

I want to say thanks to my supervisor Asst. Lecturer Mrs. Hero for helping me in writing this review article.

Finally, I want to say thanks to all those I forgot them here to mention his/her name, which assisted me even by one useful scientific word directly or indirectly.

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 **ABSTRACT**

 The present work includes a detailed redescription of the Coccinella seven spot, *coccinella septumpunctata* (Linnaeus, 1758) and coccinella eleven spot, *coccinella undicempunctata* (Linnaeus, 1758) from Kurdistan region-Iraq. The specimens were collected from the leaf of different plant during October to November of 2022. According to our morphological redescription the *C.* *septumpunctata* is rounded oval body, convex and nearly hemispherical, mandibles asymmetrical, antenna club shaped, Elytra red or yellowish brown with seven spots, Length 5.2-9.0 mm; width 4.0-65 mm, while male genitalia are short and very thick. siphonal tube long, the distal end carries sac like structure and length is (2.5-2.6) mm. Whereas *Coccinella undecimpunctata* Body has an elongated, oval, convex, mandibles asymmetrical, antenna clavate shaped, Elytra yellow to red or orange, length 4.5-5.5 mm; width 2.7-4.1 mm, while male genitalia sipho slightly curved, distally bifid siphonal capsule just flattened; length (1-1.4) mm. The diagnostic characters of the species were photographed, localities, and date of collecting were recorded.

##  INTRODUCTION

 Coccinellidae is a widespread family of beetles (Order: Coleoptera) ranging in size from 0.8 to 18 mm (Seago *et al.,* 2011). The family is commonly known as ladybirds’ beetles or lady beetles. The family is found worldwide, with over 6,000 species described (Taranto et al., 2012). The majority of coccinellid species are generally considered beneficial insects, because many species prey on herbivorous hemipterans such as aphids or scale insects, hoppers, psyllids, whiteflies and immature stages of phytophagous beetles, moths and plant mites, which are agricultural pests (Majerus *et al*., 2000).

Multivariate analyses of morphological characters showed the presence of two morphologically divergent entities in H. diekei in Indonesia; one occurring in western islands (Java, Kalimantan, Bali), and another in eastern ones (Sulawesi, Lombok, Matsubayashi *et al*. 2016). In Iraq, (Derwesh, 1965) indicated 17 species of the family Coccinellidae in 11 genera. (Abdul Rassoul 1976) recorded 17 species of the family belonging 12 genera. (Al-Ali, 1977) recorded 20 species belongs to 10 genera including the species under of the study. (Swail, 1986) recorded 14 species belonging the tribe Cicindeline (Al-Ali *et al*., 1990) listed 61 species. Adults overwinter in sheltered locations such as tree holes and other natural hiding places (Majerus *et al*., 2000). The Ladybird beetles are frequently used as research material in various fields of biological sciences, e.g., the evolutionary biology, population ecology, genetics, cytology and biogeography (Sasaji, 1971). The different classification systems have been used to classify the members of the family Coccinellidae depending on the taxonomists and many attempts have been made concerning the phylogenetic relationships among the subfamilies from different viewpoints. However, the subdivision of the family has given rise to much controversy (Kobayashi *et al*., 1998). Therefore, the aims of the current study are to describe species in detail alongside comparing all its important diagnostic characters for both species.

## LITERATURE REVIEW

## Classification of Ladybirds

 Domain: Eukaryota

 Kingdom: Animalia

 Phylum: Arthropoda

 Subphylum: Hexapoda

 Class: Insecta

 Order: Coleoptera

 Family: Coccinellidae

 Genus: Coccinella

 Species: *C. septempunctata*

*C. undecimpunctata*

 *(Linnaeus, 1758)*

## Taxonomic History of Coccinellidae

It is interesting that Linnaeus the great naturalist first biological contribution was on Coccinella. He described this genus in 1758 with its 36 European representatives. Laterille put this genus under newly established given name Coccinellidae Later on; Europen taxonomists did intensive work on this group of insects. Notable work on this family is by Mulsant (1866); Weise (1900) and Ganglbauer (1899). Family Coccinellidae was divided into two groups on the basis of their feeding habits i.e., Phytophagous and Aphidophagous (Carnivorous) by Redtenbacher (1843) and Casey (1899) divided Coccinellidae family into groups: Gymnosomids and Trichosomids. The former have hairs on their bodies and later group lacks this characteristic on their bodies. Chapius (1876) proposed novel classification of the family Coccinellidae while taxonomic keys for the determination of Palaearctic fauna were established by Crotch (1874a) and Weise (1900). Ganglbauer (1899) divided the family into three subfamilies.

The exact identification of up to species level cannot be made only relying on the presence/pattern or absence of spots on the elytra of the mostly occurring coccinellids. Earlier, some taxonomists used this character to identify and name the so-called species, but the majority of these names 7 are not valid now. With the advance in knowledge, male genitalia were made a characteristic to differentiate and properly identify the species. Verhoeff (1985), Chapin (1946), Smirnoff (1957) and Kapur (1956a and1956b) worked on taxonomy keys and gave proper description to identify certain species that are occurring in nature.

## World Distribution of Coccinellidae

May studies showed that larger areas of seminatural habitats surrounding the vineyards would result in higher abundances of Coccinellidae, and Coccinellidae were concentrated in the ground cover vegetation and in July (Taranto *et al*., 2012). Mader, (1955) studied the species of Palaearctic region. A monographic work on Palaearctic fauna was published by Mader (1926-34). First world catalogue of the family Coccinellidae was produced by Korschefsky (1931 and 1932) with the classification of three subfamilies; Epilachninae, Lithophilinae and Cossineeinae.

 This classification of Korschefsky was used as a standard for a long time. Kapur (1942) further conducted work on bionomics of Adonia variegate Goeze, Brumus suturalis (Fabr.) and Scymus quadrillum Motsch. The taxonomy of various higher categories of the family Coccinellidae has also been treated (Mader, 1955; Watson, 1956 and Bielawski, 1959).

Irshad and Khan (2005) listed many coccinellids associated with insect pests of Inayatullah et al. (2005) during an extensive survey carried out for the collection of coccinellids in district Poonch of Azad Jammu Kashmir reported 16 species in 12 genera belonging to four subfamilies, Coccinellinae, Chilocorinae, Scymninae and Epilachninae occur in the area. Subfamily Coccinellinae is well represented with 13 species viz. Coccinella septempunctata, Coccinella undecimpunctata, Coccinella transversalis, Coccinella conglobata, Oenopia sauzeti, Oenopia mimica, Propylea dissecta, Menochilus sexmaculatus, Halyzia tschitscherini, Illeis confuse, Hippodomia variegate, Leis dimediata and Lemnia bisellata.

## Economic importance of Ladybirds

Ladybirds are voracious predators and occupies important place in biological control so they are called aphidophagous or phytophagous. Depending on the species, a single lady beetle can eat as many as 5000 aphids during its lifespan (Bessin, 2013). Lady beetles are a very successful group of beneficial insects that are often used in biological control because both adult and larvae are predaceous. Some lady beetle species feed on scale insects, aphids, mites, whiteflies, ants, lacewings, lady beetle larvae, larvae of the alfalfa weevil, and psyllids (Hodek and Evan, 2012) distinguished lady beetles according to the way they feed. Beetles of the genera Hippodamia, Coccinella, and Harmonia are large, and tend to develop quickly. They are also fast moving, and lay their eggs in clusters. The advantages of using lady beetles for biological pest control has been known for centuries. Lady beetles were praised for their predacious feeding behaviors as far back as the 1800’s when it was suggested that lady beetles could be used to control pests in hot houses (De Bach, 1964).

Coccinellini was the second most abundant tribe found in the vineyards. This tribe is mainly composed by predators of aphids (Slipinski, 2013), psyllids, and Chrysomelidae (Hodek and Evan, 2012). It includes *C. septempunctata*, the third more abundant species in the study, which besides aphids (Stowe et al., 2021), feed on pollen (Hodek and Evan, 2012). In Portugal, this species is frequent in chestnuts (Santos et al., 2012), citrus groves (Magro and Hemptinne, 1999), and almond trees (Benhadi-Marín *et al*., 2011). Its peak was in July, in September was not found, and reappeared with less abundance in October. The same pattern occurred in chestnuts (Santos et al., 2010), where *C. septempunctata* had its peak in August, was almost null in September, and recovered its activity in October.

## 3.MATERIALS AND METHODS

 The specimens will be collected from the leaf of different plants which infested by *Aphis spp*. In some localities of Erbil in Kurdistan Region - Iraq. The specimens will place in boiling water for 10-15 minutes to soften their parts. Then the parts separate to three parts; head, thorax and abdomen under dissecting microscope, the head and abdomen soaked in a beaker contained 10% KOH, placed on fire with shaking for about (4-5) minutes for dissolving of lipids materials of the body and destroying the muscles. After that placed in distilled water for 2-3 minutes in order to neutralize the alkali. The parts were placed in ethyl alcohol 25% and dissected under microscope, then transferred to ethyl alcohol 50%, 75% and 100%, respectively for two minutes of each concentration for dehydration of water, then placed in xylol for two minutes, for translucency. Finally, the parts places on slides with a drop of DPX solution and covered by cover slides to prepare slides for examination (Lane and Grosskey, 1993; Mawlood *et al*., 2016; Abdulla *et al*., 2020). The species were identified with the help of available key (*Li et al*., 2015 and Mawlud *et al*., 2022).

##  4.RESULTS AND DISCUSSION

**Synonyms**

*Coccinella septumpunctata* Linnaeus, 1758

*Coccinella 7-punctata* Linnaeus, 1758: 365 (LSL)

*Coccinella septempunctata:* Korschefsky, 1932: 486 (cat.);

*Coccinella divaricata* Olivier, 1808: 1001 (lectotype; UCCC); Korschefsky, 1932: 457 (cat.);

**Description**

***Coccinella septumpunctata***

**Body** rounded oval, convex and nearly hemispherical, densely punctate, Elytra red or yellowish brown with seven spots, Length 5.2-9.0 mm; width 4.0-6.5 mm. (fig.1a).

**Head** black; nearly cup shaped, head tow times width of eyes. Eyes small and minutely faceted with pair of yellow spots on frons near eyes

**Antenna**(fig.1b) dark brown,11-segmented with 3 –segmented compact club-shaped; basal segment longer. length (1.1-1.2) mm. **labrum**(fig.1c) dark brown or black; length (0.6-0.7) mm, **mandible**(fig.1d) asymmetrical bifid apically with whitish spot at lateral margin, near the base, high sclerotized, length (0.5-.06) mm. **Maxilla** (Fig.1e) dark brown, cardo semi- rounded bare, galea dark brown, lacinia brown, hook like, maxillary palps brown to dark brown, with four palpomers length (0.9 -1) mm. **Labium** (Fig.1f) brown, mentum flat, labial palps consist of three palpomers length (0.4-0.5) mm.

 **Thorax**: pronotum black twice as broad as long, finely punctate, black with small yellow spots at anterior margins. Scutellum black, small and nearly equilateral. **Elytra** without hairs, reddish yellow glabrous, with 7 black spots, one triangular common post scutellar, one on each elytron at middle, 2 near lateral margin, length (5.0-5.1) mm, **hind wings** membranous,yellow, length (9-10) mm.

 **Legs** (fig.1h) brown to dark brown. Forecoxae elongated, beak shaped; trochanter rectangular; femur cylindrical, slightly longer than the tibia; tibia nearly tubular, surface densely yellow setose; fore tarsus four segmented, densely setose. Claw small, strongly curved with basoventral tooth. length (5 - 5.1) mm.

**Male Genitalia** (fig. 1i) Phalobase: Trab; short and very thick. Basal piece elongated. Median lobe much thick, very broad at base, Parameres relatively shorter than median lobe, covered with dense long hairs on dorsal side except base. Siphonal tube long, the distal end carries sac like structure. Length (2.5-2.6) mm.

**Abdomen** six visible abdominal sternites in both sexes; posterior margin of the six abdominal sternums, convex in the female, blunt in the male, posterior margin of the six abdominal tergite arched in the female, strongly convex in the male.









Figure 1.Coccinella septumpunctata

a. Adult b. Antenna c. Labrum d. mandible e. Maxilla f. Labi um g1. Elytra g2. Hind wing h. Leg i. Male Genetalia

Scale bare: a, g1, g2, and h= 1mm; b,c,d,e, and i = 0.5mm; f= 0.2mm

***Coccinella undecimpunctata***

synonyms

C. (Spilota) undecimpunctata menetriesi Muls., 1850)

C. menetriesi Mulsant, 1850: 104;

C. undecimpunctata aegyptiaca Reiche, 1861: 212

**Description**

**Body: -** elongate, oval, convex, densely punctate, Elytra yellow to red or orange, length 4.5-5.5 mm; width 2.7-4.1 mm (fig. 2a)

**Head:** black, with a small oval pale spot adjacent to each eye, eyes small with minute facets, **Antenna** (fig.2b) dark brown, 11-segmented with compact 3-segmented, clavate shaped, length (0.8-0.9) mm, **mandible**(fig.2c) asymmetrical, with two light spots on its base length (0.3-0.4)mm. **Labrum**(fig.2d) transverse dark brown or black;length (0.4-0.5) mm. **Maxilla** (Fig.2e) dark brown, cardo semi- rounded bare, galea dark brown, lacinia brown, hook like, maxillary palps brown to dark brown, with four peplomers. length (0.7-0.8) mm.

**Labium** (Fig.2f) brown, mentum trapezoid, labial palps consist of three peplomers, length (0.3-0.4) mm.

 **Thorax**: pronotum dark black with large oval pale spot in each anterior angle. **Elytra** (Fig.2g1) yellowish red, or orange with 11-black spots, scutellar, and five spots per elytron, length (2.9-3) mm, **hind wing** (Fig.2g2) membranous (5-6) mm.

**Legs** (Fig.2h) dark brown, length (2-3) mm, coxae elongated, beak shaped, trochanter rectangular; femur cylindrical, tibiae of middle and hind legs with two apical obvious spurs, tarsi 4-segmented, tarsal claws with subquadrate basal tooth.

**Abdomen**: six visible abdominal sternites in both sexes, entirely black; apical margin of the sixth abdominal sternum in the female convex, blunt in the male, the apical end of the last tergite in the female, strongly convex, while in the male regularly convex, tergites dark brown; sternites dark black.

**Male Genitalia** (Fig.2i) Sipho slightly curved, distally bifid siphonal capsule just flattened; basal piece elongated with slight emargination; basal lobe well thickened, broadest proximally, length (1-1.4) mm.



Figure 2. Coccinella undecimpunctata

a. Adult b. Antenna c. mandible d. Labrum e. Maxilla f. Labium g1. Elytra g2. Hind wing h. Leg i. Male Genetalia

Scale bare: a, i, g1, g2, and h= 1mm; b,c,d, f and i = 0.5mm.

Table 1: Comparison between *C.septumpunctata* & *C.undecimpunctcta*.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Name of species** | **Length (mm)** | **Width****(mm)** | **Body shape** | **Head** | **Pronotum** | **Elytra** |
| *C.septumpunctata* | 5.2-9.0 mm | 4.0-6.5mm | rounded oval, convex and nearly hemispherical | black; nearly cup shaped | black with small yellow spots at anterior margins | Elytra reddish yellow glabrous, 7 black spots |
| *C.undecimpunctcta*  | 4.5-5.5mm | 2.7-4.1mm | elongate, oval, convex | black, oval shaped | dark black with large oval pale spot in each anterior angle | yellowish red, or orange 11-black spots |

Our founded results are agreed with the results of Michaud, *et al*. (2008) and Aristízabal and Arthurs (2014) which they studded and illustrated that Coccinella septempunctata has a bright orange body and are oval in shape and is 7.24mm long and 5.50mm wide, also the legs, thorax and abdomen are fully deep black in color. Whereas, the demonstrations of Wheeler et al. (1981) and Ali, *et al*. (2012) about the *Coccinella undecimpunctata* showed that they have a yellowish body, with the adult body length is 5.3mm and the width is 4.7mm, and head Length 1.2-1.3 mm; width 1.5-1.7 mm; eyes large with minute facets; labrum with anterior margin emarginated; tormae somewhat elongated, which are almost approved our results on the same species.

Some researchers such as (Inayatullah and Siddiqui, 1980; Khan *et al.* 1999a ;Inayatullah *et al*. 2005 and Rafi *et al*. 2005) have worked on the comparative anatomy of head capsule, thorax and abdomen of *C. septumpunctata* and *C. undecimpunctata* as we did in our project and we got nearly the same results as those researchers, which they described the external morphology of predatory ladybirds *Coccinella undecimpunctata* Linnaeus, 1758 superficially similar to *C.* *septempunctata* but smaller in size. Therefore, sometime it is confused with *C.* *septempunctata.* These two species can be separated by spotted pattern, in the case of *Coccinella undecimpuncta,* elytra red with 11 black spots of nearly different size.

**CONCLUSIONS**

The results of this study presented the comparison between two species of ladybirds which are *C. septumpunctata* and *C. undecimpunctata*. The study comprised a detailed description and photographing the important parts which used in species identification especially. Therefore, the results illustrated that both species were near and almost similar to each other based on the different sizes of parts. However, they can be distinguished based on the number of spots. So that it is necessary to do a comprehensive survey of different regions of Iraq, to collect the samples and update the database of the family coccinellidae upon of both methods phylogenetics and morphological study differentiation.

##

## REFERENCES

Abdulla, B.S., Ahmmed, S. H., Mawlood, N. A. and Omar, Z. Z. (2020). A New record of European chafer beetles, Amphimallon majale (Razoumowsky, 1789) (Coleoptera: Melolonthidae) from Iraq. Plant Archives. 20 (2): 6357-6361.

Abdul-Rassol, M.S. (1976). Checklist of Iraq natural history museum insect collection, Natural History Research Center Iraq. Publication, : 30-41.

Ali, A.S.A. and Hama, N.N. (2016). Integrated management for major date palm pests in Iraq. Emirates Journal of Food and Agriculture, pp.24-33.

Ali, M., Perveen, R., Siddique N.Y. and Hussain, R. (2012). Redescription of three species of the genus Coccinella (Coleoptera: Coccinellidae) from Sindh, Pakistan. Pak. Entomol., 34(2): 167-171.

Al-Ali, A.S. (1977). Phytophagous and entomophagous insects and mites of Iraq. Natural History Research Center, Publication, : 33-142.

Al-Ali, H. A., Abdul-Rassoul, M. S. and Swail, M.A. (1990). Systematic list of Coccinellidae recorded for Iraq. Bull. Iraq. Nat. Hist. Mus., 8(3): 45-51.

Al-Rubeae, J.K. and Al-Al-Hajiya, K.A. (2012). Effects of population densities of black bean nymph on biological performance of the predator larvae of *coccinella septempunctata* l. iraqi journal of agricultural Sciences, 43(2), pp.18-27.

Aristízabal LF and Arthurs SP. (2014).Convergent lady beetle, *Hippodamia convergens* Guérin-Méneville *UF/IFAS Featured Creatures*.

Bessin, R. (2013). LadyBugs. University of Kentucky College of Agriculture. <http://www2.ca.uky.edu/entomology/entfacts/ef105.asp>

Benhadi-Marín, J.; Pereira, J.A.; Barrientos, J.A.; Bento, A. and Santos, S.A.P. (2011). Diversity of predaceous arthropods in the almond tree canopy in Northeastern Portugal: A methodological approach. Entomol. Sci., 14 :347–358.

Bielawski, R., (1959). Klucze do oznaczanica Owador Poliski Part 19. Tom. 76. Coleoptera, 76. Coccinellidae Panwyal Wyd. Nawk. Warzawa, : 92.

Casey, T. L. (1899). A revision of the American Coccinellidae. Journal of New York Entomological Society, 7: 71-169.

Chapin, E. A. 1946. Review of the new world species of Hippodamia Dejean (Coleoptera: Coccinellidae). Smithsonian. Miscellaneous Collections, 106(11): 39.

Chapuis, F. (1876). Historie naturelle des insect Genera des Coleopteres. Paris, 12, :424.

Crotch, G. R. (1874a). Description of new species of Coleoptera from Pacific Coast of the United States. Transactions of the American Entomological Society, 5: 73-80.

De Bach, P. (Ed.) (1964). Biological Control of pests & weeds. Chapman & Hall, London. :844.

Derwesh, A.I. (1965). A preliminary list of identified insects and arachnids of Iraq. Direct. Gen. Agri. Res. Proj. Baghdad. Bull, :121-123.

Ganglbauer, L. (1899). Die Kafer Von Mitteleuropa Band 3 Wein. :1044.

Hippa, H. (1978). On the feeding biology of *Coccinella hieroglyphica* L.(Col., Coccinellidae).

Hodek, I. and Evans, E.W. (2012). Food relationships. In Ecology and Behaviour of the Ladybird Beetles (Coccinellidae); Hodek, I., Honek, A., Van Emden, H.F., Eds.; Wiley-Blackwell: Chichester, UK,: 143–238.

Inayatullah, and Siddiqui, E.M. (1980). Comparative skeletal anatomy of the thorax of Coccinella septempnctata L.and Coccinella undecimpunctata L. (Coleoptera: Coccinellidae) P. J. Zool., 12 (2): 225-237.

Inayatullah, M., Hayat, A. and Rafi, M.A. (2005). Species composition, distribution and seasonal occurrence of Coccinellidae (Coleoptera) in District Poonch, Azad Kashmir with new records. Sarhad J. Agric., 21: 97-100.

Irshad, M. and Khan, M. R. (2005). Insect pests of plants and their parasitoids, predators and pathogens in Pakistan. PIPS (Pvt) Limited : 72.

Kapur, A. P. (1956a). Systematic and biological notes on the Ladybird beetles predacious on the San jose scale in Kashmir with description of a new species (Coleoptera: Coccinellidae). Records of Indian Museum, 52 (1954): 257-274.

 Kapur, A.P. (1956b). A new species of Coccinellidae (Coleoptera) predacious on the citrus whitefly in India. Records of the Indian Museum, 52 (1954): 189-193.

Khan, M.R., Sheikh, M.K., Rafi, M.A. and Sharif, A. (1999a). Predatory coccinellid fauna (Coleoptera: Coccinellidae) of Sudhnuti District, Azad Jammu and Kashmir. Pak. J. Ent., 14: 5-7.

Kobayashi, N., Tamura, K., Aotsuka, T. and Katakura, H. (1998). Molecular phylogeny of twelve Asian species of epilachnine ladybird beetles (Coleoptera, Coccinellidae) with notes on the direction of host shifts. Zoological science, 15(1):147-151.

Korschefsky, R. (1931). Coleopterorum catalogue Pars. 118 Coccinellidae. I. Berlin, : 224.

 Korschefsky, R. (1932). Coleopterorum Catalogus. Pars 120. Coccinellidae II. Berlin, : 435.

Lane, R. P. and R.W. Crosskey (1993). Medical insects and arachnids. The Natural History Museum. Chapman and Hall, London.

Li, W., Huo, L., Wang, X., Chen, X. and Ren, S. (2015). The genera Exochomus Redtenbacher, 1843 and Parexochomus Barovsky, 1922 (Coleoptera: Coccinellidae: Chilocorini) from China, with descriptions of two new species. Source: Pan-Pacific Entomologist, 91(4):291-304.

Mader, L. (1926–34). Evidenz der palaarktischen Coccinelliden und ihrer Aberrationen in Wort und Bild. I. Teil.: Epilachnini, Coccinellini, Halyziini, Synonychini, Zeitschrift des Vereines der Naturbeobachter. Wien .336 s. 1926. N 1: 1-24; 1927. N 2: 25-48. 1928, N 3: 49-76; 1929. N 4: 77-124; 1930. N 5: 125-168; 1931. N 6: 169-204; 1932. N 7: 205-244; 1933. N 8: 245-288; 1934. N 9: 289-336.

Mader, L. 1955. Evidenz der palaearktischen Coccinelliden und ihrer Aberrationen in Wort und Bild. II. Teil. Entomologische Arbeiten aus dem Museum G. Frey, Bd. 6: 765-1035.

Magro, A. and Hemptinne, J.L. (1999). The pool of coccinellids (Coleoptera: Coccinellidae) to control coccids (Homoptera: Coccoidea) in Portuguese citrus groves. Bol. Sanid. Veg, 25: 311–320.

Majerus, M.E., Hinrich, J., Schulenburg, G.V.D. and Zakharov, I.A. (2000). Multiple causes of male-killing in a single sample of the two-spot ladybird, Adalia bipunctata (Coleoptera: Coccinellidae) from Moscow. Heredity, 84(5):605-609.

Matsubayashi, Kei W.; Kahono, S., Hartini, S., Fujiyama, N. and Katakura, H. (2016). Redescription of the phytophagous ladybird beetle Henosepilachna diekei and descriptions of two related species from Indonesia (Coccinellidae, Coccinellinae, Epilachnini). Insecta matsumurana. New series: journal of the Faculty of Agriculture Hokkaido University, series entomology, 72, 1- 16.

Mawlud, D. H., Abdulla, B. S., Faraj, A.M. and Mawlood, N. A. (2022). Description Of Pine Ladybirds Beetle, Exochomus Quadripustulatus (Linnaeus, 1758) (Coleoptera: Coccinelidae) From Kurdistan Region-Iraq. Natural Volatiles & Essential Oils, 9(1): 1034-1040.

Mawlood, N.A., Hamad, M. I. and Abdullah, Y. M. (2016). A new record of glaphyrid scarab beetles, Eulasia vitatta (Fabricius, 1775) (Coleoptera, Glaphyridae) from Erbil Kurdistan region-Iraq. Zanco Journal of Pure and Applied Sciences, 28(3): 1-4.

Michaud JP, McCoy CW and Futch SH. (2008). Ladybeetles as biological control agents in citrus. EDIS. http://edis.ifas.ufl.edu/hs138 (no longer available online)

Minchin, D. (2010). A swarm of the seven-spot ladybird *Coccinella septempunctata* (Coleoptera: Coccinellidae) carried on a cruise ship. European Journal of Entomology, 107(1) :127.

Mulsant, M. E. (1866). Monographie des Coccinellides, 1. Coccinellidens . Paris, :294

Rafi, M.A., Irshad, M. and Inyatullah, M. (2005). Predatory adybird beetles of Pakistan. PARC/NWFP Agric.Univ. Roohani Art Press, Islamabad, Pakistan,: 105.

Redtenbacher, L. 1843. Tentamen dispositionis generum et specierum Coleopterorum Pseudotrimerorum Archiducatus Austriae. Vindobonae, 32.

Santos, S.A.; Pereira, J.A.; Nogueira, A.J.A. (2010). Response of coccinellid community to the dimethoate application in olive groves in northeastern Portugal. Span. J. Agric. Res., 1:126–134.

Santos, S.A.P.; Raimundo, A.; Bento, A.; Pereira, J.A. (2012). Species abundance patterns of coccinellid communities associated with olive, chestnut and almond crops in northeastern Portugal. Agric. For. Entomol. 14 :376–382.

Sasaji, H. (1971). Fauna Japonica: Coccinellidae. (Insecta: Coleoptera.). Academic Press of Japan, : 340.

Seago, A. E., Giorgi, J. A. Li, J. and Adam, S. (2011). Phylogeny, classification and evolution of ladybird beetles (Coleoptera: Coccinellidae) based on simultaneous analysis of molecular and morphological data. Molecular Phylogenetics and Evolution. 60 (1): 137–151.

Slipinski, A. (2013). Australian Ladybird Beetles (Coleoptera: Coccinellidae): Their Biology and Classification; CSIRO Publishing: Clayton, Australia.

Smirnoff, W. A. 1957. La cochenille du palmier dattier (Parlatoria blanchardii Targ.) en Afrique du Nord comortement, importance, economique, predateurs et lutte biologique. Entomophaga, 2: 1-98.

Stowe, H.E.; Michaud, J.P. and Kim, T.N. (2021). Floral resources enhance fecundity, but not flight activity, in a specialized aphid predator, Hippodamia convergens (Coleoptera: Coccinellidae). Front. Ecol. Evol., 9: 748870.

Swail, M. A. (1986). Taxonomic study on Tribe Coccinellini in Iraq. MSc. Thesis. University of Baghdad. : 90.

Taranto, L. Rodrigues, I., Santos, S.A.P., Villa, M. and Pereira, J.A. (2022). Response of the Coccinellidae Community within Sustainable Vineyards to the Surrounding Landscape. Agronomy, 12(9): 2140-2153.

Verhoeff, C. (1985). Beitrage sur verglechenden Morphologie des Abdomens der Coccinelliden und uber die Hinterleibsmuskulatur von Coccinella, Zugleich versuch die Coccinelliden anatomisch zu bergunden und naturlich zu gruppiren. Archiv Naturg, 61: 1-80.

Watson, W. Y. A. (1956). A study of the phylogeny of genera of the tribe Coccinellini (Coleoptera). Contrib. Roy. Ontarion Museum Div. Zool. Palaeontol. : 42-52.

Weise, J. (1900). Coccinellidae aus Ceylon gesammelt von Dr. Horn. Deutsche Entomologische Zeitschrift. Bd. 44: 417-448.

Wheeler Jr, A.G. and Hoebeke, E.R. (1981). A revised distribution of *Coccinella undecimpunctata* L. in eastern and western North America (Coleoptera: Coccinellidae). The Coleopterists' Bulletin, pp.213-216.