

Original article (Özgün makale)

Mealybug (Hemiptera: Pseudococcidae) predators of the family Coccinellidae (Coleoptera) from Aydın Province, Türkiye

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Türkiye, Aydın İli'nde Coccinellidae (Coleoptera) familyasına bağlı Unlubit (Hemiptera: Pseudococcidae) avcıları

Öz: 2019 yılında Aydın İli'nde gerçekleştirilen bu çalışmada, tarım ve tarım dışı alanlarda unlubit bulaşık bitkiler üzerindeki Coccinellidae familyasına ait predatör türler araştırılmıştır, Unlubitler ile bulaşık 22 farklı konukçu bitki üzerinde Coccinellidae familyasına ait 10 predatör türü tespit edilmiştir. Tespit edilen bu türlerin gelecekte biyolojik mücadele uygulamaları için kitle üretimde önemli bir bilgi alt yapısı oluşturabileceği düşünülmektedir.

Anahtar kelimeler: Aydın, Uğur böcekleri, doğal düşmanlar

Abstract: In this study, which was carried out in Aydın Province of Türkiye in 2019, predatory species belonging to the Coccinellidae family on mealybug infested plants in agricultural and non-agricultural areas, are reported and discussed. Ten predator species belonging to the Coccinellidae family were identified from 22 host plant species infested with mealybugs. These predator species are promising candidates for mass rearing for biological control purposes in the future.

Keywords: Aydın, Ladybugs, natural enemies

Introduction

Pseudococcidae (Hemiptera: Coccoomorpha) is a large family spread over wide areas of the world in terms of the number of species. Many new pseudococcid species have been identified in systematic faunistic studies conducted in different geographic areas, and many species are first records for the country they are found in (García Morales et al. 2016). Similarly, new mealybug species have been identified in

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agricultural and non-agricultural areas in Türkiye, and many species have been recorded for the first time there (Ülgentürk et al. 2022; Yerlikaya et al. 2023). According to Scalenet data, 112 mealybug species have been reported from Türkiye (García Morales et al. 2016). Some of these species cause significant damage in agricultural and landscaped areas (Kaydan et al. 2005; Telli & Yiğit 2019a,b; Yerlikaya et al. 2023). The toxic substances they secrete during their feeding can cause deformations of plant tissues, yellowing of leaves and cessation of plant growth. In addition, by exuding the excess plant sap they consume during their feeding, they reduce the quality and quantity of the fruit with damage called “sooty mould” (Uygun et al., 1998). Moreover, some pseudococcid species are virus vectors (Bertin et al. 2010; Cid et al. 2010; Mekuria et al. 2013; Wistrom et al. 2016; Palma-Jiménez et al. 2019).

Chemical control alone is not effective enough for reasons such as high reproductive potential, feeding in sheltered parts of the plant, resistance problems and residue risk (Chong et al. 2015). Thus, it is recommended to use natural enemies within the scope of integrated pest management (Dinesh & Venkatesha 2011; Qin et al. 2019).

Many studies have reported that mealybug populations can be significantly reduced by their natural enemies (Muniappan et al. 2006; Sultan et al. 2021). Parasitoids and predators are among these natural enemies, and species of the Coccinellidae family have an important status among the predatory species (Gautam et al. 2007; Fand et al. 2010; Saengyot & Burikam 2011; Nazari et al. 2018; Seyfollahi et al. 2019). In earlier studies, many species belonging to the Coccinellidae family have been identified in close association with mealybugs (Kaydan et al. 2006; Jalilvand et al. 2014; Yiğit & Telli 2014; Peronti et al. 2016; Poorani & Lalitha 2018; Telli & Yiğit 2019a,b; Sá et al. 2020; El Aalaoui & Sbaghi 2021). In this study, predatory species belonging to the Coccinellidae family (coccinellids) that were found on mealybug infested plants in agricultural and non-agricultural areas in Aydın Province, Türkiye are listed and discussed.

Materials and Methods

Samples were collected from natural and agricultural areas in Aydın city center and its districts in Türkiye in 2019 after examining the roots, root collars and green parts of plants in those areas. The samples were taken in order to determine the species belonging to the family Pseudococcidae and the predatory species of the family Coccinellidae associated with them. All samples were numbered and labeled and the GPS coordinates of their collection places were recorded. In the laboratory, culturing and preparation studies were carried out in order to identify the collected pseudococcid species and their coccinellid predators. Female adult pseudococcid species were slide mounted by using the methods of Kosztarab & Kozár (1988) at Aydın Adnan Menderes University, Sultanhisar, Aydın, Türkiye, with some modifications (cleaning the samples with a fine brush using sterile water after KOH treatment). A Leica DM2500 phase-contrast binocular microscope was used for the identification of pseudococcid species. For the identifications, the identification keys of Danzig & Gavrillov-Zimin (2014, 2015), Danzig (1990, 2001a, 2001b, 2003),

Kaydan (2015), Kosztarab & Kozar (1988), Marotta (1992), Tereznikova (1975) and Ter-Grigorian (1973), were used.

Adult coccinellid specimens seen on the mealybug colonies were collected with an aspirator and placed in killing jars. Larvae found on mealybug colonies were collected together with the plant part that they were found on, then taken to the laboratory and cultured, and adult coccinellids were obtained. The preparation of the coccinellid species was carried out using the methodology of Uygun (1981). For this purpose, the killed coccinellid adults were fixed at their ventral surfaces to individual triangular cardboard baseplates. Water-based, easily dissolved, odorless and colorless adhesive was used in the bonding process. Finally, a small rectangular note containing the specimen's details was then pinned on the wide part of each specimen's baseplate.

The coccinellid specimens were identified by Prof Nedim Uygun (Çukurova University, Faculty of Agriculture, Department of Plant Protection, Adana), according to methodology of Uygun (1981).

Results and Discussion

List of Coccinellidae collected in Aydın Province, Türkiye in 2019

Genus *Chilocorus*

1. *Chilocorus bipustulatus* (Linnaeus)

Material Examined: Aydın: 1 individual, Kuşadası (37°50'34"N, 27°14'48"E), 19 m, 13.vi.2019, ex *Planococcus vovae* on *Cupressus macrocarpa*, leg. H. Yerlikaya, Coll. No: 45.

Genus *Exochomus*

2. *Exochomus nigromaculatus* (Goeze)

Material Examined: Aydın: 3 individuals, Nazilli (37°54'53"N, 28°19'40"E), 126 m, 30.v.2019, ex *Planococcus vovae* on *Cupressus macrocarpa*, leg. H. Yerlikaya, Coll. No: 30; 1 individual, Efeler (37°50'37"N, 27°50'00"E), 55 m, 2.vii.2019, ex *Planococcus citri* on *Citrus aurantium*, H. Yerlikaya, Coll. No: 119; 4 individuals, Efeler, (37°50'39"N, 27°51'08"E), 60 m, 12.x.2019, ex *Planococcus citri* on *Nerium oleander*, leg. H. Yerlikaya, Coll. No: 483.

Genus *Hippodamia*

3. *Hippodamia variegata* (Goeze)

Material Examined: Aydın: 1 individual, Kuşadası (37°43'06"N, 27°13'19"E), 4 m, 14.vi.2019, ex *Pseudococcus longispinus* on *Euonymus japonicus*, leg. H. Yerlikaya, Coll. No: 62; 1 individual, Koçarlı (37°43'56"N, 27°50'14"E), 46 m, 6.x.2019, ex

Phenacoccus madeirensis on *Amaranthus viridis*, leg. H. Yerlikaya, Coll. No: 474; 4 individuals, Efeler, (37°52'13"N, 28°01'16"E), 76 m, 3.xi.2019, ex *Phenacoccus solenopsis* on *Hibiscus rosa-sinensis*, leg. H. Yerlikaya, Coll. No: 511.

Genus *Nephus*

4. *Nephus hiekei* (Fürsch)

Material Examined: Aydın: 1 individual, Köşk (37°51'20"N, 28°03'26"E), 72 m, 9.vii.2019, ex *Planococcus ficus* on *Ficus carica*, leg. H. Yerlikaya, Coll. No: 176; 5 individuals, Didim (37°24'57"N, 27°25'15"E), 19 m, 24.vii.2019, ex *Phenacoccus solenopsis* on *Solanum lycopersicum*, leg. H. Yerlikaya, Coll. No: 236; 6 individuals, Efeler (37°50'01"N, 27°51'03"E), 39 m, 2.viii.2019, ex *Phenacoccus madeirensis* on *Ocimum basilicum*, leg. H. Yerlikaya, Coll. No: 282; 7 individuals, Nazilli (37°54'25"N, 28°15'43"E), 104 m, 5.viii.2019, ex *Phenacoccus solenopsis* on *Lantana camara*, leg. H. Yerlikaya, Coll. No: 314; 1 individual, Efeler (37°49'51"N, 27°50'36"E), 41 m, 28.viii.2019, ex *Phenacoccus solenopsis* on *Amaranthus viridis*, leg. H. Yerlikaya, Coll. No: 344; 4 individuals, Efeler (37°49'17"N, 27°49'48"E), 40 m, 2.viii.2019, ex *Phenacoccus madeirensis* on *Gazania rigens*, leg. H. Yerlikaya, Coll. No: 356; 1 individual, Köşk, (37°52'04"N, 28°05'12"E), 99 m, 3.ix.2019, ex *Phenacoccus madeirensis* on *Helianthus tuberosus*, leg. H. Yerlikaya, Coll. No: 361; 3 individuals, Kuyucak (37°54'46."N, 28°35'34"E), 105 m, 7.ix.2019, ex *Heterococcus nudus* on *Sorghum halepense*, leg. H. Yerlikaya, Coll. No: 389; 2 individuals, Efeler (37°51'22"N, 27°54'34"E), 72 m, 10.ix.2019, ex *Phenacoccus parietaricola* on *Parietaria judaica*, leg. H. Yerlikaya, Coll. No: 408; 1 individual, Efeler (37°51'05"N, 27°54'32"E), 57 m, 10.ix.2019, ex *Dysmicoccus angustifrons* on *Echium angustifolium*, leg. H. Yerlikaya, Coll. No: 409; 3 individuals, Germencik (37°52'07"N, 27°38'48"E), 36 m, 23.ix.2019, ex *Phenacoccus phenacoccoides* on *Sorghum halepense*, Coll. No: 453; 2 individuals, Efeler (37°49'47.2"N, 27°50'48"E), 44 m, 30.ix.2019, ex *Phenacoccus solenopsis* on *Mirabilis jalapa*, leg. H. Yerlikaya, Coll. No: 464.

5. *Nephus includens* (Kirsch)

Material Examined: Aydın: 2 individuals, Efeler (37°49'45"N, 27°50'45"E), 44 m, 30.ix.2019, ex *Planococcus citri* on *Rosa* sp., leg. H. Yerlikaya, Coll. No: 467.

6. *Nephus macilentus* Kirsch

Material Examined: Aydın: 3 individuals, Köşk (37°50'08"N, 28°00'51"E), 50 m, 9.vii.2019, ex *Dysmicoccus angustifrons* on *Althaea officinalis*, leg. H. Yerlikaya, Coll. No: 170.

7. *Nephus nigricans* Weise

Material Examined: Aydın: 1 individual, Köşk (37°50'08"N, 28°00'51"E), 50 m, 9.vii.2019, ex *Dysmicoccus angustifrons* on *Althaea officinalis*, leg. H. Yerlikaya, Coll. No: 170; 1 individual, Sultanhisar (37°53'16"N, 28°09'35"E), 72 m, 9.vii.2019, ex *Planococcus vovae* on *Cupressus sempervirens*, leg. H. Yerlikaya, Coll. No: 172; 1 individual, Koçarlı (37°45'39"N, 27°49'55"E), 39 m, 31.vii.2019, ex *Planococcus vovae* on *Juniperus communis*, leg. H. Yerlikaya, Coll. No: 264.

Genus *Rodalia*

8. *Rodalia cardinalis* (Mulsant)

Material Examined: Aydın: 3 individuals, Söke (37°45'18"N, 27°24'25"E), 46 m, 19.v.2019, ex *Pseudococcus longispinus* on *Pittosporum tobira*, leg. H. Yerlikaya, Coll. No: 12.

Genus *Scymnus*

9. *Scymnus levaillanti* (Mulsant)

Material Examined: Aydın: 1 individual, Kuşadası (37°44'01"N, 27°17'30"E), 60 m, 14.vi.2019, ex *Planococcus citri* on *Citrus aurantium*, leg. H. Yerlikaya, Coll. No: 70.

10. *Scymnus subvillosus* Goeze

Material Examined: Aydın: 1 individual, Söke (37°45'18.0"N, 27°24'25"E), 31 m, 19.v.2019, ex *Planococcus vovae* on *Cupressus sempervirens*, leg. H. Yerlikaya, Coll. No: 9; 17 individuals, Efeler (37°51'15"N, 27°50'39"E), 83 m, 26.v.2019, ex *Planococcus vovae* on *Cupressus macrocarpa*, leg. H. Yerlikaya, Coll. No: 16; 17 individuals, Kuşadası (37°50'34"N, 27°14'48"E), 19 m, 13.vi.2019, ex *Planococcus vovae* on *Cupressus macrocarpa*, leg. H. Yerlikaya, Coll. No: 45; 1 individual, Didim (37°20'55"N, 27°16'28"E), 15 m, 3.vii.2019, ex *Planococcus vovae* on *Cupressus macrocarpa*, leg. H. Yerlikaya, Coll. No: 134; 1 individual, Didim (37°21'27"N, 27°16'31"E), 12 m, 3.vii.2019, ex *Planococcus citri* on *Citrus aurantium*, leg. H. Yerlikaya, Coll. No: 142; 7 individuals, Köşk (37°51'20"N, 28°03'26"E), 72 m, 9.vii.2019, ex *Planococcus ficus* on *Ficus carica*, leg. H. Yerlikaya, Coll. No: 176; 1 individual, Köşk (37°51'33"N, 28°02'51"E), 82 m, 9.vii.2019, ex *Planococcus vovae* on *Cupressus sempervirens*, leg. H. Yerlikaya, Coll. No: 177; 2 individuals, Efeler (37°50'59"N, 27°45'51"E), 49 m, 15.vii.2019, ex *Pseudococcus longispinus* on *Jasminum officinale*, leg. H. Yerlikaya, Coll. No: 186; 3 individuals, Didim, (37°22'47"N, 27°16'12"E), 39 m, 24.vii.2019, ex *Planococcus citri* on *Euonymus japonicus*, leg. H. Yerlikaya, Coll. No: 231; 1 individual, Efeler (37°49'13"N, 27°50'06"E), 40 m, 2.ix.2019, ex *Planococcus vovae* on *Cupressus sempervirens*, leg. H. Yerlikaya, Coll. No: 355; 1 individual, Efeler (37°50'58"N, 27°48'50"E), 65 m, 21.ix.2019, ex *Planococcus vovae* on *Cupressus macrocarpa*, leg. H. Yerlikaya, Coll. No: 445.

Conclusions

In this study, 10 predator species from the family Coccinellidae were found. They were collected with 10 mealybug species during a survey on 22 host plant species in Aydın Province in Türkiye. The most common coccinellid species in the samples was *Scymnus subvillosus* and most of them were collected from with *Planococcus vovae* on *Cupressus* sp.. The second most common species was *Nephus hiekei* and most of them were collected with *Phenacoccus solenopsis* and *Ph. madeirensis* on ornamental plants. The number of the coccinellids was more numerous in non-agricultural areas than in agricultural areas. This result supports the protection of non-agricultural areas in terms of natural enemy populations which contribute to the control of pest species in agricultural areas. Intensive study of the biology, ecology and mass rearing of the predatory coccinellids is fundamental to the improvement of biological control programs.

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