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Original article (Orijinal araştırma)

New scale insect (Hemiptera: Coccomorpha) records for the Turkish Republic of Northern Cyprus

Kuzey Kıbrıs Türk Cumhuriyeti için yeni kayıt coccoid (Hemiptera: Coccomorpha) türleri

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Summary

Surveys of scale insects were carried out on infested fruits and ornamental plants in the Turkish Republic of North Cyprus during July 2013. Nine scale insect species were determined, four of which are new records for the Turkish Republic of Northern Cyprus fauna. The new records include: *Anophococcus formicicola* (Newstead) (Acanthococcidae), *Aulacaspis yasumatsui* Takagi (Diaspididae), *Parasaissetia nigra* (Nietner) (Coccidae), and *Phenacoccus maderiensis* (Green) (Pseudococcidae).

Keywords: Invasive species, *Planococcus ficus*, *Ceroplastes floridensis*, *Coccus hesperidum.*

Özet

Bu çalışmada Kuzey Kıbrıs Türk Cumhuriyeti'ne Temmuz 2013 yılında sürveyler düzenlenmiş ve coccoidler ile bulaşık meyve ve süs bitkilerinin farklı organları örneklenmiştir. Çalışma sonucunda *Anophococcus formicicola* (Newstead) (Acanthococcidae), *Aulacaspis yasumatsui* Takagi (Diaspididae), *Parasaissetia nigra* (Nietner) (Coccidae) ve *Phenacoccus maderiensis* (Green) (Pseudococcidae) türleri ülke için yeni kayıt olmak üzere dokuz coccoid türü belirlenmiştir.

Anahtar sözcükler: İstilacı türler, *Planococcus ficus*, *Ceroplastes floridensis*, *Coccus hesperidum*

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Introduction

Insect pests have been spreading rapidly in recent decades due to the increase in trade of plant species. Scale insects (Hemiptera: Coccomorpha) that are often cryptic in habit, can escape detection during quarantine inspections of plants. If scale insects are introduced without their natural enemies into a new environment they can establish in the new area easily and have the potential to be economically important pests (Miller et al., 2002; Wang et al., 2009; Joshi et al., 2010; Wang et al., 2010; Kaydan et al., 2012; Kaydan et al., 2013; Ülgentürk et al., 2014; Halima-Kamel et al., 2015; Ibrahim et al., 2015). Invasive species can sometimes affect the biodiversity of local organisms, modify habitats and cause extensive environmental and economic harm (Muniappan et al., 2011). Pelizzari & Germain (2010) indicated that 129 scale insect species from Asia and tropical regions entered into Europe up to their review in 2010. Recent interceptions and introductions of alien scale insects in European and Mediterranean countries were detected by Pellizzari & Porcelli (2014) and Ülgentürk et al. (2014). They include the following species: (*Antonina pretiosa* Ferris, *Exallomochlus hispidus* (Morrison), *Ferrisia virgata* (Cockerell), *Palmicultor lumpurensis* (Takahashi), *Trabutina mannipara* (Hemprich & Ehrenberg) (Pseudococcidae), *Coccus viridis* (Green), *Milviscutulus mangiferae* (Green) (Coccidae), *Aonidiella orientalis* (Newstead), *Aspidiotus destructor* Signoret, *Aulacaspis tubercularis* Newstead, *Batarasa lumampao* Takagi, *Fiorinia fioriniae* Targioni Tozzetti, *Lepidosaphes pinnaeformis* (Bouché), *Odonaspis serrata* Ben-Dov; *Poliaspoides bambusae* Ülgentürk & Pellizzari, *Poliaspoides formosana* (Takahashi), *Pseudaulacaspis brimblecombei* Williams (Diaspididae), *Phoenicococcus marlatti* Cockerell (Phoenicococcidae) and their current distribution. Halima-Kamel et al. (2015) reported the pink hibiscus mealybug *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae) on *Hibiscus rosa-sinensis* (Malvaceae) and *Phenacoccus peruvianus* Granara de Willink (Hemiptera: Pseudococcidae) on *Bougainvillea glabra* (Nyctaginaceae) and *Citharexylum quadrangularis* (Verbenacae) from different localities in Tunisia.

Cyprus is the largest island in the Mediterranean. It has tropical and subtropical climate that is suitable for invasive scale insects to reproducte and spread through the whole island. Şişman & Ülgentürk (2010) detected 53 scale insect species in the northern part of Cyprus. Recently it has been recorded that *M. hirsutus* and *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) occur on the island (EPPO, 2011). The aim of this study is to present some new invasive coccoid species from the Turkish Republic of Nothern Cyprus.

Materials and Methods

The surveys were carried out in the Turkish Republic of North Cyprus in July 2013. Individual scale insects were removed from infested fruit and ornamental plants and preserved in 70% ethanol. All insects were mounted on glass slides according to the procedure described by Kosztarab & Kozár (1988) for identification. The identifications were made using publications by Gill (1988), Kosztarab & Kozár (1988), Williams (2004) and Miller & Davidson (2005). Synonyms and distribution of each species were taken from Ben-Dov et al. (2015). All the specimens were collected by the first author.

Dry and mounted specimens are deposited in Ankara University, Agricultural Faculty, Plant Protection Department, Dışkapı, Ankara, Turkey.

Results and Discussion

In this study, nine scale insect species were determined, four of which are new records for Cyprus fauna. According to the Invasive Species Compendium, an alien species is defined as a species that become established in natural or semi-natural ecosystems or habitat and is an agent of change, and threatens native biological diversity (CABI, 2015). Some coccoid species that have been distributed to new areas have became serious pests (Miller et al., 2002; Wang et al., 2009; Joshi et al., 2010; Wang et al., 2010; Kaydan et al., 2012; Kaydan et al., 2013; Ülgentürk et al., 2014; Halima-Kamel et al., 2015; Ibrahim et al., 2015). In Northern Cyprus, high density populations of mealybugs were found in parks and

gardens. *Coccus hesperidum, Ceroplastes floridensis, Planococcus ficus* are common species on the island (Şişman & Ülgentürk, 2010), and recently *Maconellicoccus hirsitus* and *P. solenopsis* was recorded as invasive pest species (EPPO 2011).

Acanthococcidae

***Anophococcus formicicola* (Newstead) ***

Synonym. *Nidularia formicicola* Lindinger; *Acanthococcus formicicola* Miller & Gimpel; *Eriococcus cynodontis* Kiritchenko; *Rhizococcus cynodontis* (Kiritchenko), Danzig; *Acanthococcus cynodontis* Tereznikova.

Material examined. 7 ♀♀ *Cynodon dactylon* 23.vii.2013, Girne

Anophococcus formicicola has a Palaearctic distribution and it occurs in Algeria, Bulgaria, Croatia, Cyprus Island, Greece, Hungary, Italy, Malta, Russia, Slovenia, Spain, Switzerland, Turkey and Ukraine (Kozar et. al., 2013). This species was collected from *Cynodon dactylon* L. (Pers.), *Elymus farctus* L., *Festuca* sp., *Hyparrhenia hirta* (L.) Stapf., *Sedum* sp., *Setaria* sp. (Poaceae) (Kozar et al. 2013).

Coccidae

***Ceroplastes floridensis* Comstock**

Synonym. *Ceroplastes vinsonii* Signoret; *Ceroplastes floridensis*; Bodenheimer; *Cerostegia floridensis*; De Lotto; *Paracerostegia floridensis*; Tang.

Metarial examined. 4 ♀♀, ex *Ficus benjamina* L. (Moraceae), 23.vii.2013 Girne, 21.vii.2013, Lefkoşa; 4 ♀♀, ex *Hibiscus rosa-sinensis* L. (Solanaceae), 2 ♀♀, ex *Salix* spp., 3 ♀♀ ex *Hedera helix*, 18.vii. 2013, Magusa.

Ceroplastes floridensis is a polypagous species and it is distributed in Afrotropical, Australasian, Nearctic, Neotropical, Oriental and Palaearctic regions (Ben-Dov et al., 2015). Şişman & Ülgentürk (2010) recorded *C. floridensis* on *Citrus* sp. (Rutaceae), *Eriobotrya japonica* (Thunb.) Lindl. (Rosaceae), *Laurus nobilis* L. (Lauraceae) and *Nerium oleander* L. (Apovynaceae) in Northern Cyprus. All stages of *C. floridensis* were found in high densities on host plants (Figure 1 a).

***Coccus hesperidum* Linnaeus**

Synonym. *Calypticus laevis* Costa; *Calypticus hesperidum*; Costa; *Lecanium hesperidum* Burmeister; *Coccus patellaeformis* Curtis; *Chermes lauri* Boisduval; *Lecanium angustatus* Signoret; *Lecanium lauri* Signoret; *Lecanium maculatum* Signoret; *Kermes aurantj* Alfonso; *Lecanium alienum* Douglas; *Lecanium depressum simulans* Douglas; *Lecanium minimum* Newstead; *Lecanium assimile amaryllidis* Cockerell; *Lecanium terminaliae* Cockerell; *Lecanium ceratoniae* Gennadius; *Lecanium hesperidum lauri* Cockerell; *Lecanium nanum* Cockerell; *Lecanium minimum pinicola* Maskell; *Lecanium flaveolum* Cockerell; *Lecanium ventrale* Ehrhorn; *Lecanium hesperidum alienum* Cockerell; *Lecanium* (*Calymnatus*) *hesperidum pacificum* Kuwana; *Coccus angustatus* Fernald; *Chermes aurantii* Fernald; *Lecanium hesperidum minimum* Newstead; *Coccus* (*Lecanium*) *minimus*; Cockerell; *Coccus flaveolus* Fernald; *Coccus hesperidum alienus* Fernald; *Coccus hesperidum lauri* Fernald; *Coccus hesperidum pacificus* Fernald; *Coccus maculatus* Fernald; *Coccus minimus* Fernald; *Coccus minimus pinicola* Fernald; *Coccus nanus* Fernald; *Coccus terminaliae* Fernald; *Coccus ventralis* Fernald; *Eulecanium assimile amaryllidis* Fernald; *Lecanium signiferum* Green; *Lecanium punctuliferum* Green; *Saissetia punctulifera* Sanders; *Lecanium hesperidum* Borg; *Lecanium* (*Coccus*) *hesperidum* Pettit & McDaniel; *Coccus* (*Lecanium*) *hesperidum* Hall; *Coccus hemisphaerides* Lindinger; *Lecanium esperidum* Gomez-

Menor Ortega; *Coccus jungi* Chen; *Lecanium mauritiense* Mamet; *Lecanium* (*Coccus*) *hesperidum* Green; *Lecanium* (*Coccus*) *signiferum* Green; *Coccus hisperidum* Chou; *Coccus mauritiensis* Mamet.

Material examined. 3 ♀♀, ex *Citrus* sp. (Rutaceae), 5 ♀♀, ex *Ficus sycomorus* L., 2 ♀♀, ex *F. benjamina* (Moraceae), 17.vii. 2013, Magusa; 3 ♀♀, ex *F. benjamin,* 23.vii.2013, Girne.

Coccus hesperidum is a polypagous and cosmopolitin species. It was determined on *Citrus* sp., *Citrus reticulata* Blanco (Rutaceae), *Laurus nobilis* (Lauraceae) and *Acacia saligna* (Labill.) H.L.Wendl. (Fabaceae) in Northern Cyprus (Şişman & Ülgentürk, 2010).

Parasaissetia nigra* (Nietner)

Synonym. *Lecanium nigrum* Nietner; *Lecanium depressum* Targioni Tozzetti; *Lecanium depressum simulans* Douglas; *Lecanium begoniae* Douglas; *Lecanium caudatum* Green; *Lecanium nigrum begoniae* Cockerell; *Saissetia nigra* Cockerell; *Coccus nigrum* Kirkaldy; *Saissetia nigra* King; *Coccus caudatus* Fernald; *Saissetia depressa* Fernald; *Lecanium* (*Saissetia*) *pseudonigrum* Kuwana; *Lecanium* (*Saissetia*) *sideroxylium* Kuwana; *Saissetia pseudonigrum* Sasscer; *Saissetia cuneiformis* Leonardi; *Coccus signatus*; Gowdey; *Lecanium* (*Saissetia*) *signatum* Newstead; *Lecanium* (*Saissetia*) *nigrum nitidum* Newstead; *Saissetia perseae* Brain; *Saissetia* (*Lecanium*) *nigra*; Hall; *Lecanium* (*Saissetia*) *crassum* Green; *Coccus asiaticus* Lindinger.

Material examined. 8 ♀♀, ex *Ficus sycomorus* L. (Moraceae), 17.vii.2013, Magusa.

Parasaissetia nigra originatese from Africa (Hodgson, 1994) and now it has spread widely in tropical and subtropical regions. It feeds on more than 400 plant species (Ben-Dov, 2015). It prefers ornamental plants such as: *Abutilon* spp. and *Hibiscus* spp. (Malvaceae), *Codiaeum* spp. (Euphorbiaceae), *Ficus* spp. (Moraceae), *Nerium* spp., and *Plumeria* spp. (Apocynaceae) (Kosztarab, 1997), but also attacks tropical fruits such as *Annona cherimola* Mill. (Annonaceae), *Carica papaya* L. (Caricaceae), *Mangifera indica* L. (Anacardiaceae), *Persea americana* Mill. (Lauraceae), *Punica granatum* L. (Lythraceae) and cotton (*Gossypium* spp., Malvaceae) (EPPO, 2002). It is restricted to indoor plants in northern Europe but it also feeds and is distributed on outdoor plants in warmer parts of Europe (Pellizzari & Germain, 2010; Malumphy & Badmin, 2012; EFSA, 2013). It has one generation in a year in outdoor conditions in California and Florida (Gill, 1988). In Mexico (Tamaulipas), at least two generations of *P. nigra* on mistletoe (*Phoradendron* spp.: Santalaceae) were observed (Myartsev et al., 2014).

We detected different biological stages and moderate densities of populations of *P. nigra* only on *Ficus sycomorus* (Moraceae) in Magusa (Figure 1e).

Diaspididae

***Aulacaspis yasumatsui* Takagi**

Material examined. 12 ♀♀ *Cycas* sp., 18.vii.2013, Magusa

The cycad scale was described for the first time in Thailand and since then it has been recorded in some parts of the Afrotropical, Australasian, Nearctic, Neotropical, Oriental and Palaearctic regions (Ben-Dov et al., 2015). In Europe, it was recorded in Bulgaria, Crotia, France, Germany, Hungary, Netherlands and United Kingdom (Germain, 2001; Miller & Davidson, 2005; Masten & Simala, 2008; Trencheva et al., 2010; Malumpy & Marquart, 2012). This species has a limited host range and feeds on *Cycas* sp. (Cycadaceae), *Dioon* sp., *Encephalartos* sp., *Microcycas* sp., *Strangeria* sp. (Stangeriaceae) and *Macrozamia* sp. (Zamiaceae). *A. yasumatsui* was likely introduced through the import of cycad plants

from infested countries. *A. yasumatsui* is considered to be a serious pest of cycads in Florida and Hawaii (Miller & Davidson 2005).

We detected infested potted cycad plants at a supermarket in Magusa. The plants were heavily coated with a white colored scale insect and plants desiccated and brown (Figure 1 d, e).

Pseudococcidae

***Maconellicoccus hirsutus* (Green)**

Synonym. *Phenacoccus hirsutus* Green; *Phenacoccus glomeratus* Green; *Spilococcus perforatus* De Lotto; *Paracoccus pasaniae* Borchsenius.

Material examined. 8 ♀♀, ex *Albizzia* sp. (Fabaceae), 10 ♀♀, ex *Ligustrum* sp. (Oleaceae), Magusa, 19.vii.2013; 6 ♀♀, ex *Jasminum sambac* (L.) Aiton (Oleaceae), 12 ♀♀, ex *Hibiscus rosa-sinensis* L. (Malvaceae), 23.vii. 2013, Girne.

Maconellicoccus hirsitus is likely native to southern Asia (Williams, 2004) and it has been accidentally introduced to other parts of the world (Kairo et al., 2000; Halima-Kamel et. al., 2015). It is a highly polyphagous mealybug species and feeds over 200 plant genera; including economic important agriculture and forest crops such as, beans, cane, citrus, coffee, cotton, coconuts grape, guava, maize, peanuts, rose, soursop, soybean, sugar, and fiber crops (Ranjan, 2006; Ujjan & Shahzad, 2007; Reddy et al., 2009). *M. hirsitus* causes deformated and stunted stems and leaves. Besides reducing the aesthetic value of the plant, this deformation can also lead to decreased crop yields and in heavy infestations lead to plant mortality (Kairo et al., 2000; Chong et al., 2008; Gonzalez-Gaona et al., 2010). The total annual cost of control and damages to the US economy from *M. hirsutus* is estimated to be US$700 million, with the global estimate being US$ 5 billion (Ranjan, 2006). The EPPO of Cyprus recently informed about the occurrence of *M. hirsutus* on *Hibiscus rosa-sinensis, Vitis* spp. (Vitaceae) and *Psidium guajava* L. (Myrtaceae) on its territory (EPPO, 2011)

We detected *M. hirsutus* in city parks and gardens. Very high population levels were observed with large quantities of mealybug wax, deformated leaves, large amounts of honeydew and the occurence smooty mold on host plants (Figure 1b).

***Phenacoccus madeirensis* Green (Madeira mealybug)**

Synonym. *Phenacoccus grenadensis* Green & Laing; *Phenacoccus harbisoni* Peterson.

Material examined. 4 ♀♀, ex *Hibiscus rosa-sinensis L.* (Malvaceae), 5 ♀♀, ex *Ligustrum* sp. (Oleaceae), 19.vii.2013; Magusa; 5 ♀♀, ex *Hibiscus rosa-sinensis,* 1 ♀, ex *F. benjamin* 23.vii. 2013, Girne

Phenacoccus maderiensis is a polyphagous species and feeds on 152 plant species of different families. It is considered to be Neotropical in origin (Williams, 2004) and is now widespread in the Afrotropical, Australasian, Nearctic, Neotropical, Oriental and Palaearctic regions. In Europe, it was recorded in Crete, France, Greece, Italy, Madeira Islands, Portugal, Sicily and Spain (Ben-Dov et al., 2015). Recently, it was found in Turkey (Kaydan et al., 2012) and Tunisia (Halima-Kamel et. al., 2014). The Madeira mealybug is harmful on potato crops in Peru (Ben-Dov, 1994) and recently it is reported a serious pest on basil (*Ocimum basilicum* L.: Lamiaceae) in Greece (Papadopoulou & Chryssohoides, 2012).

***Phenacoccus solenopsis* Tinsley (The solenopsis or cotton mealybug)**

Synonym. *Phenacoccus cevalliae* Cockerell; *Phenacoccus gossypiphilous* Abbas, Arif & Saeed.

Material examined. 15 ♀♀, ex *Ligustrum* sp. (Oleaceae), 19.vii.2013, Magusa.

Phenacoccus solenopsis is a polyphagous and invasive species (Miller et al., 2002, Wang et al., 2009, Joshi et al., 2010, Wang et al., 2010). The mealybug has been reported in more than 40 countries across all inhabited continents (Ben Dov et al., 2015). The solenopsis mealybug is listed as a serious pest on cotton especially in Asian countries (Arif et al., 2009; Hodgson et al., 2008; Mahalakshmi et al., 2010; Wang et al., 2010). It was found on ornamental plants and *Capsicum annuum* (L.) and *Lycopersicum esculantum* Mill. (Solanaceae) in Turkey (Kaydan et al., 2013). Ibrahim et al. (2015) recorded this species as a new pest on tomato (*Lycopersicon esculentum* Mill.) in Egypt. This mealybug was recorded on *Abelmoschus esculentus* (L.) Moench*, Chrysanthemum* sp. (Asteraceae)*, Hibiscus rosa-sinensis* L. (Malvaceae)*, Lantana* sp. (Verbenaceae) and *Vitis* spp. (Vitaceae), mainly in private gardens in Cyprus (EPPO, 2011). CLIMEX prediction models revealed that *P. solenopsis* has the potential to invade worldwide and establish populations in more than 100 countries, mainly in tropical and subtropical zones (Wang et al., 2010). It was detected at very high population levels on *Ligustrum* sp. (Figure 1c).

***Planococcus ficus* Signoret**

Synonym*. Dactylopius ficus* Signoret ; *Dactylopius subterraneus* Hempel; *Pseudococcus ficus*; Fernald; *Coccus vitis*; Lindinger; *Pseudococcus citrioides* Ferris; *Planococcus citrioides* Ferris; *Planococcus vitis* Ezzat & McConnell.

Material examined. 2 ♀♀, ex *Viburnum* sp. (Adoxaceae), 18.vii.2013, Magusa.

P. ficus is distributed in Afrotropical, Nearctic, Neotropical, Oriental, Palaearctic regions (Ben-Dov et al., 2015). It is a pest of grapevine in the Mediteranean region, South Africa, Pakistan and Argentina (Ben-Dov, 1994). *P. ficus* transmits Grapevine Leafroll Associated Virus 3 (GLRa V-3) (Ben-Dov et al., 2015).

This cosmopolitin species was recorded on *N. oleander* in Magusa previously by Şişman & Ülgentürk (2010).

Concluding remarks. In this study, the majority of the scale insects which were new records for Cyprus were found on ornamental plants. It was suggested that these insects were introduced to the island via plant trade. Scale insects have a high potential to spread to new areas via plant movement because of their cryptic nature. Scale insects can easily escape quarantine inspections, when insects are hidden between leaf bases, stems or roots. The absence of natural enemies on this island, stimulate rapid increasing populations of scale insects in newly infested areas.

Figure 1. *Ceroplastes floridensis* (a), *Maconellicoccus hirsitus* (b), *Phenacoccus solenopsis (c) Aulacaspis yasumatsui* (d,e) and *Parasaissetia nigra* (f) on different host plants.

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