# PEST STATUS OF *DACTYLOPIUS OPUNTIAE* (COCKERELL) (HEMIPTERA: DACTYLOPIIDAE) AND NEW RECORDS OF SCALE INSECTS FROM NORTHERN TURKISH REPUBLIC OF CYPRUS

**Selma Ülgentürk* and Sema Şişman Hocaali****

* Ankara University, Facuty of Agriculture, Department of Plant Protection, 06110, Ankara, TURKEY. E-mail: ulgentur@agri.ankara.edu.tr
** Vadi St., No: 4, Vadili, Famagusta NORTHERN TURKISH REPUBLIC OF CYPRUS.

**[Ülgentürk, S. & Şişman Hocaali, S.** 2019. Pest status of *Dactylopius opuntiae* (Cockerell) (Hemiptera: Dactylopiidae) and new records of scale insects from Northern Turkish Republic of Cyprus. Munis Entomology & Zoology, 14 (1): 294-300**]**

ABSTRACT: Cyprus has the ideal geographical and climatic conditions for the reproduction and spread of many insect species that accidentally enter the country by imported live plant materials. This work was carried out in the Turkish Republic of Northern Cyprus in 2017-2018 as part of the investigation on the harmful species on Babutsa (*Opuntia ficus-indica*). It was found that *Dactylopius opuntiae* (Cockerell) (Hemiptera: Dactylopiidae) spreads aggressively in the the cacti cultivated for fruit and also infected some ornamental cacti in Famagusta Province, almost destroyed Prckly pear cactuses of closed Maraş Region. *Diaspis echinocacti* (Bouché) was found to be a relatively common pest species in ornamental cacti. Moreover, ornamental plants in the parks and gardens were severely infected by *Pinnaspis aspidiastrae* (Signoret) (Diaspidae) and *Pulvaria floccifera* Westwood (Coccidae). *D. echinocacti, P. aspidiastrae* and *P. floccifera* are new records for the insect fauna of Northern Turkish Republic of Cyprus. Information on biology, host plants, distribution, damage and control methods of these species, especially in cactuses, are given.

KEY WORDS: Prikly pear Cochineal, carmine dye, babutsa, barbary fig, scale insects

Many plants are transported to new areas for amateur or commercial purposes or because of its beauty. These activities can cause unwanted pests to jump to new areas, as well as the insects which were never encountered before (Pellizzari & Germain, 2010).

Cyprus is an island located in the eastern Mediterranean Sea and the Mediterranean climate prevails. Its climate and geographic location are suitable for the development of subtropical and tropic plants and insects. *Opuntia ficus - indica* (L.) Miller (Caryophyllales; Cactaceae) is one of many imported plants to the island. It is called barbary fig, cactus pear, Indian fig, Indian prickly pear, mission fig, babutsa (in the Northern Cyprus) etc., but preferred common name is prickly pear. Prickly pear is the most widespread and most commercially important cactus species that mostly due to production of the dye from prickly pears cochineal scale [*Dactylopius coccus* Costa (Hemiptera: Dactylopiidae)] on these cacti that spread almost whole the world. Prickly pear is also used as commercial fruit, fodder crop and more recently as part of forestry or agroforestry projects in some countries. It grows in arid and semi-arid areas either as an agricultural crops or a weed. On the other hand, it constitutes an environmental issue when the plant has become invasive such as in Australia and South Africa (Annecke & Moran, 1978; Torres & Giorgi, 2018). Nowadays in North Cyprus, this plant is either grown for fruit and used as an ornamental plant. The fruits are consumed as fresh and as marmalade. Prickly pear (Babutsa) is an important plant in the culture and cuisine of the people of The Northern Cyprus.

Recently new invasive species in Northern Cyprus *Aulacaspis yasumatsui* Takagi, 1977 (Hemiptera: Diaspididae), *Maconellicoccus hirsutus* (Green, 1908), *Phenacoccus madeirensis* Green, 1923 and *Phenacoccus solenopsis* Tinsley, 1898 (Hemiptera: Psudococcidae) on various ornamental plants were recorded by Ülgentürk et al. (2015). Lastly *Dactylopius opuntiae* (Cockerell, 1896) (Hemiptera: Dactylopiidae) was determined on *O. ficus -cacti* in Northern Cyprus (Eppo, 2017). Shortly after that, the growers began to complain about a pest that harmful and rapidly widespread on Cactus (Babutsa) and help request to control it. Surveys carried out in cooperation with the Northern Turkish Republic of Cyprus Ministry of Agriculture and the Union of Agricultural Engineers were investigated in Cactus plantation Famagusta, Closed Maraş Region and Nicosia. In communication information on prickly pears cochineal scale, its control methods and other new scale insect species for Turkish fauna are given.

## MATERIAL AND METHODS

The scale insects were collected from infested cactus and ornamental plants with scale insects in Maraş provinces (buffer zone) between north and south Cyprus, Famagusta and Nicosia in 2017-2018 (Fig 1). Samples were examined under stereomicroscope. Slides were mounted (Kosztarab & Kozár, 1988) and identification was carried out according to De Lotto (1974), Kosztarab & Kozár (1988), Williams & Watson (1990) and Miller & Davidson (2005). The new records of fauna are marked with '*'.

## RESULTS AND DISCUSSION

In this study 1 Coccidae, 1 Dactylopiidae and 2 Diaspididae are determined in parks and gardens of Famagusta and Nicosia. Scale insects are given in alphabetic order. Synonyms, host plants, distribution of scale insect are taken mainly from ScaleNet (Garcia et al., 2016).

### *Pulvaria floccifera* (Westwood) *
### The cotony camelia scale (Coccidae)

**Examined material:** Nicosia/Centrum, *Leucophyllum* sp., 27.IV. 2018; Nicosia/Centrum, *Thevetia peruviana,* 27.IV.2018.

It has very heavy population on ornamental plants gardens in Nicosia. It excretes very big amount of honeydew. The host plants are covered honeydew and sooty mold (Fig. 1a). female lays eggs in an ovisac located behind its body (Fig. 2a).

*P. floccifera* is a polyphagous insect with more than 80 host plant species belonging to 35 families and is considered an important pest of fruit trees and ornamentals in many parts of the World (Kosztarab & Kozar, 1988; Garcia et al., 2016). It is a known tea pest in Black Sea Region (Alkan, 1956) and ornamental plants in Marmara Region in Turkey (Ülgentürk et al., 2008). Recently, the cottony camellia scale has been reported as the most important pest of citrus and tea orchards in the Middle East (Abd-Rabou et al., 2012; Naeimamini et al., 2014). In Europe, this coccid has been recorded on indoors and outdoors ornamental plants in almost all countries (Kosztarab & Kozar, 1988; Ben-Dov & Sánchez–Garcia, 2015; Logowska et al., 2017).

***Dactylopius opuntiae* (Cockerell)**
**False Prickly pear cochineal (Dactylopiidae)**

**Examined material:** Famagusta/Closed Maraş Region, *Opuntia ficus–cacti*, 13.viii.2017, Famagusta/ Closed Maraş Region, *O. ficus–cacti*, 27.iv.2018; Famagusta/ İskele, *Opuntia* spp., 20.viii.2018; Famagusta/ Yeniboğaziçi, *Opuntia* spp. 16.ix.2018; Famagusta/ Muratağa, *Opuntia* spp. 16.ix.2018; Famagusta/ Beyarmudu, *Opuntia* spp., 16.ix.2018; Famagusta/ Çayönü, *O. ficus-cacti*, 16.ix.2018; Famagusta/İncirli, *O. ficus-cacti*, 16.ix.2018; Famagusta/ Sandal, *Opuntia* spp. 16.ix.2018.

The female, pupae, and various stages of immature occur together on cactus. The pupae were placed upside down or perpendicular to the plant (Fig. 2b). The female of *D. opuntiae* is oval in shape, cover themselves with white flocculent waxy secretions (Fig. 2c). If these white cotton-type waxy cover removed and the insect bodies are crushed, then they release the dark red dye 'carmine'. Slide–mounted specimens broadly oval, anal lobes poorly developed. Antennae are normally with 7, occasionally with 6 segments. Legs are well developed, stout, each leg without a tibio-tarsal articulatory sclerosis. Anal ring is modified, situated slightly forward from apex of abdomen. Pores characteristic, quinquelocular of two types: wide and narrow–rimmed in varying size of clusters (Williams & Watson, 1990). In addition, two aduts of *Scymnus (Pullus) subvilonus* (Bozy) (Coleoptera: Coccinellidae) associated with *D. opuntiae* colonies in Famagusta/Closed Maraş Region were found. It is possible that it is an opportunistic predator.

Prickly pear cochineal sucks sap of cactus. The feeding point becomes surrounded by yellow areas and the cladodes collapse and may later drop off. Cactus in Closed Maraş Region were totaly collaps by *D. opuntiae* (Fig. 2d) after first determination in year 2017 (Eppo, 2017). It is in the situation of an outbreak in whole Closed Maraş region. First report of *D. opuntiae* was only in Closed Maraş Region (Eppo, 2017) but in only one year the scale has widespread to Villages such as Beyarmudu, Çayönü, Muratağa, İncirli, İskele Sandal, Serdarlı and Yeni Boğaziçi although a mechanical and chemical combat program against *D. opuntiae* has been implement by the Ministry of Agriculture of Turkish Republic of Northern Cyprus. This situation hows how *D. opuntiae* spreads so rapidly and increase uncontrolled in a new entering area (Fig. 1e).

*D. opuntiae* is native to Mexico and neighboring countries in Central America and it is known as false prickly pear cochineal. It is recorded from more than twenty countries (Garcia et al., 2016), recently in Israel (Spodek et al., 2014), Lebanon (Moussa et al., 2017), Morocco (Bouharroud et al., 2016) and Spain (Ben-Dov & Sánchez–Garcia, 2015). Palafox-Luna et al. (2018) reported that the development of *D. opuntiae* on *O. ficus-indica* was completed in 16.78±2.69 d in females and 24.48±2.23 d in males. The fecundity of females with food (established on cladodes) was higher (567.58±164.67 individuals) compared to the females without the food (351.25±131.98). On the other hand Flores-Hernandez et al. (2006) determined that female and male of *D. opuntiae* have completed their biological cycle in 77 and 43 days respectively on *Opuntia megacantha* Salm Dyck in Mexico. The oviposition period is 21 days with an average of 131 insects per female. The sex ratio was 1:1 (♀:♂). *D. opuntiae* is belonging to Dactilopiidae which has 11 species that feed exclusively on cactus species (Caryophyllales: Cactaceae) (Garcia et al., 2016). Although *Dactylopius coccus* Costa is most commercially cultivated species of *Dactylopius* because of the higher amount and quality of dye it contains, all species produces carminic acid which can be used in the cosmetic, food, pharmaceutical and textile

industries (Serrano et al., 2013). *D. opuntiae* is multiple generation in a year and shorter life cycle than *D. coccus*. Therefore *D. opuntiae* is more aggressive species than *D. coccus* (Torres & Giorgi, 2018). It spread rapidly to semiarid region and caused a huge problem cactus production as fodder, fruit or fence. It has been used to for biological control noxious cactus weed in Australia and South Africa (Zimmermann & Moran, 1991).

***Diaspis echinocacti* (Bouché)***
**Cactus scale (Diaspididae)**

**Examined material:** Nicosia, *O. ficus-cacti*, 16.v.2017; Famagusta, *Opuntia* spp. 27.iv.2018.

Female cover is white, circular and flat, exuvia when rubbed is dark brown. It occurs central to subcentral. Body of female is yellowish white. Male cover is elongate oval, white, with 3 longitudinal ridges; exuvia is marginal, white (Fig. 2e). Feeding of cactus scale is caused chlorotic areas on the cactus pad, subterranean crown and roots. It has 2 generations per year in greenhouse in Russia. Female laid about 100 to 200 eggs (Oetting, 1984). Its damage appears to variable according population level, presences of natural enemies, or susceptibility of various host plant (Miller & Davidson, 2005). Cactus scale recently has become a problem on prickly pear (*O. ficus-indica*) on some farms in Sicily, requiring specific measures of chemical control (Russo & Siscaro 1994). This species is considered to be an important world pest by (Miller & Davidson, 2005).

***Pinnaspis aspidistrae* (Signoret)***
**Fern Scale ( Diaspididae)**

**Examined material:** Nicosia, *Dypsis lutescens*, 4 ♀♀, 27.iv.2018,

A large population is observed on ornamental plants which occur severe chlorosis and brown dead areas of leaves. Female cover narrowly to broadly olyster-shell shaped, light to dark brown, exuvia occurs marginal, yellowish brown to brown. Male cover smaller white, felted, elongate with 3 ridges, exuvia is marginal, pale yellow. Body of female is yellow in color. According Miller & Davidson (2005), Fern scale is important pest banana, citrus, fern and foliage plants, fruit of oil palm, and rubber trees in various countries.

**Control of scale insects**

Prevention is one of the best options when dealing with any kind of pest. At this point, avoid infested plants with scale insect and avoid transmit contaminated plants to new areas. The growers should avoid buying any seeding materials from infested areas. The crawlers can be move from plant to plant if the plants touch each other. Therefore, sufficient intervals between plants should be provided. In addition, crawlers in infested plants can be airborne by winds. They can also be carried passively by human, insect etc. The nymphs place around the bud or where the branches, leaves and fruits touch each other. The infested part of plant with scale insects should be prune off and heavy infested plants should cut off mechanically. In Northern Cyprus cactus which is heavily infested with *D. opuntiae*, is destroyed by pruning off. Biological control is very successful on scale insects because of their a sedentary life. In addition, the results can be easily monitored. Although there are many natural enemies of scale insect in nature. It is necessary to choose the ones that are effective. *Microterys flavus* (Howard) (Hymenoptera: Encyrtidae) and *Exochomus flavipes* Thrum (Coleoptera: Coccinellidae) were reported as efficient natural enemies on *P. floccifera* in Egypt

(Abd-Rabou & Badary, 2005). Although many predators of *D. opuntiae* was reported in the World, but very few species that are effective and can complete their development on Prickly pear scale (Vanegas-Rico et al., 2010; Cruz-Rodriquez et al., 2016) *Zagreus bimaculosus* (Mulstant) (Coleoptera: Coccinellidae) was preyed and completed their development both on *D. opuntiae* and *D. echinocactii* in laboratuvar condition (Torres & Giorgi, 2018). *Plagiomerus diaspidis* (Hymenoptera: Encyrtidae) was the most effective natural enemy of D. *echinocactii*, giving rates of parasitism greater than 40% (Miller & Davidson, 2005). In addition that Protasov et al. (2017) reported that biological control with *Cryptolaemus montrouzieri* Mulstant (Coleoptera: Coccinellidae) were unsuccesful on *D. opuntiae* in Israel, while *C.montrouzieri* has the potential to suppress *D. opuntiae* populations to an acceptable level and reduce the damage caused by prickly pear cochineal in Morocco ( Bouharroud et al., 2018). Specific strains of the *Fusarium incarnatum–equiseti* species complex were found to be efficient in controlling this insect under both laboratory and field conditions (Carneiro-Leão et al., 2017).

The recommended chemical control against *D. opuntiae* is primarily use mixtures of neutral soaps with synthetic insecticides (thiamethoxam, thiamethoxam and lambda-cyhalothrin, a mixture of imidacloprid and bifenthrin) and alternatively to use detergent oil, neem oil and mineral oil (Torres and Giorgi, 2018). The organophosphate (dimethoate) is proved above 90% mortality of *D. opuntiae* but killed natural enemies in similar rate as well (Brito et al., 2008). Therefore, control measures based on the use of mineral oils, biopesticides (neem, etc.) and neutral soaps can be advised to protect natural enemies. In conclusion, integrated pest management should be used to control scale insect on cactus.

## ACKNOWLEDGEMENTS

The authors thank to the Ministry of Agriculture of Turkish Republic of Northern Cyprus and the Union of Agricultural Engineers for the support of research, Prof. Dr. Nedim Uygun (Çukurova Universiy) and Dr. Zuhal Dilaver (Ankara University) for determination of Coccinellidae and host plant species respectively. The authors would like to thank Murat Çetiner (General Directorate of Forestry, Ministry of Agriculture and Forestry) for drawing the map. The article was presented as poster in VII. Plant Protection Congress, 14-17 November 2018, Muğla.

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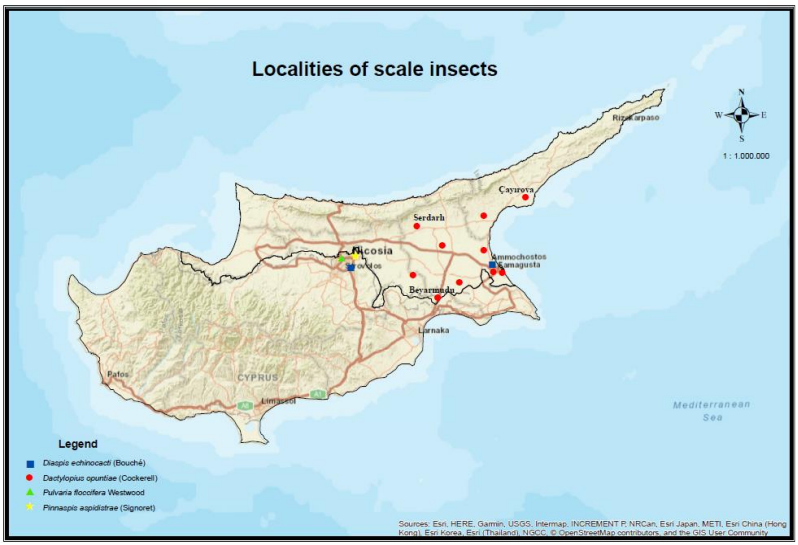


Figure 1. Localities of scale insect in Northern Cyprus.


Figure 2. *Pulvinaria floccifera* (a,b), *Dactylopius opuntiae* (c,d) and its damage (f) and *Diaspis echinocacti* (e).