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Dactylopius opuntiae (Cockerell, 1896), a new invasive pest of the cactus plants *Opuntia ficus-indica* in the South of Lebanon (Hemiptera, Coccoidea, Dactylopiidae)

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Abstract. − The scale insect *Dactylopius opuntiae* (Cockerell, 1896) (Hemiptera, Dactylopiidae) was detected for the first time in southern Lebanon in 2012, in the region of Nabatieh, on the cactus plants *Opuntia ficus-indica* (L.) Mill. (Cactaceae). The survey conducted in 2014 showed that this new introduced species is widespread in the South of the country and that the damages are very severe on Barbary figs, whose fruits constitute additional income sources for farmers of the region. However, in 2015, new infestations were observed in the region of Jezzine and Chouf, situated at 18 km from the first site of detection. The predator *Cryptolaemus montrouzieri* (Coleoptera, Coccinellidae) was found in association with the colonies of *D. opuntiae*, but its densities were too low to regulate the population of this new invasive pest. *D. opuntiae* represents a considerable threat to the production of Barbary figs in Lebanon.

Résumé. − ***Dactylopius opuntiae* (Cockerell, 1896), un nouveau ravageur invasif des figuiers de Barbarie, *Opuntia ficus-indica*, au Sud Liban (Hemiptera, Coccoidea, Dactylopiidae)**. La cochenille *Dactylopius opuntiae* (Cockerell, 1896) (Hemiptera, Dactylopiidae) a été signalée pour la première fois au sud du Liban en 2012 dans la région du Nabatieh sur *Opuntia ficus-indica* (L.) Mill. (Cactaceae). La surveillance effectuée en 2014 a montré que ce nouveau ravageur est largement répandu au sud du pays et que les dégâts sont très sévères sur les figuiers de Barbarie dont les fruits contribuent au revenu des agriculteurs de la région. Cependant une nouvelle infestation a été observée en 2015 dans les régions de Jezzine et du Chouf, situées à 18 km du premier site de détection. Le prédateur *Cryptolaemus montrouzieri* (Coleoptera, Coccinellidae) était observé en association avec les colonies de *D. opuntiae* mais son abondance était insuffisante pour pouvoir contrôler la population de cette espèce envahissante. La cochenille *D. opuntiae* représente une menace considérable pour la production des figues de Barbarie au Liban.

Keywords. – Scale insects, cactus pests, Barbary fig.

Dactylopius Costa, 1835 (Hemiptera, Dactylopiidae) is a genus of scale insects with only eleven species (De Lotto, 1974; Perez-Guerra & Kosztarab, 1992; Ben-Dov & Marotta, 2001; Van Dam & May, 2012). They feed exclusively on cacti plants of the genus *Opuntia* (Cactaceae) (De Lotto, 1974; Perez-Guerra & Kosztarab, 1992; Claps & de Haro, 2001). All the species of *Dactylopius* have similar appearance: body of an adult female is dark red, oval in shape and covered with white waxy filaments. Nymphs and adult females live in aggregations on cladodes usually at the base of the spines and feed on the sap causing the death of their hosts. In this context, five species of *Dactylopius* have been used successfully as biological control agents to eradicate *Opuntia* species in countries where cacti are considered as weeds (Moran & Zimmermann, 1984; Singh, 2004). In 1863, *D. ceylonicus* (Green, 1896) was introduced in Sri Lanka to control *O. vulgaris* Mill. (Tyron, 1910); *D. opuntia*e (Cockerell, 1896) was released against *O. stricta* (Haw.) Haw. in Australia in 1921 (Dodd, 1936; Hosking *et al*., 1994) and against *O. ficus-indica* Mill. in South Africa in 1933 (Annecke & Moran, 1978; Chávez-Moreno *et al*., 2011), whereas *D. austrinus* (De Lotto, 1974) was released onto *O. aurantiaca* Lindl. in South Africa (Moran *et al*., 1982). On the opposite, the cochineal *Dactylopius* become a major pest

in the regions where cactus plants have an economic importance in the agriculture production and the rural development as additional income sources for the farmers.

In 2012, *Dactylopius* sp. was detected for the first time in the region of Nabatieh in the south of Lebanon on the cactus plant *Opuntia ficus-indica*. The pathway for the introduction in the country is still unclear. The identification of the genus was done by the laboratory of entomology at the Lebanese Agriculture Research Institute (LARI). For two consecutive years, the insect continued to disperse to other regions, attacking more cactus plants. In 2014, a survey was conducted by the LARI and the faculty of Sciences at the Lebanese University to study the distribution area of this new invasive pest and to evaluate the level of infestation of the cactus in order to implement a national strategy to manage the problem and reduce the economic losses of *Opuntia ficus-indica* in Lebanon.

Method of survey

The survey was conducted between August 20th and September 22nd, 2014. Since the insect is host-specific, 90 sites were visited over the country based on the geographic distribution of *Opuntia ficus-indica* in Lebanon. According to Chalak *et al.* (2012), this cactus is cultivated along the coastal and the mountainous areas from the south to the north of Lebanon within an altitude of up to 900 m. It is found dispersed on the littoral and inland zones on the border of olives groves and other orchards or in backyards as a boundary hedge. However, seven commercial plantations with a surface area between 1 and 3 ha have been established: one in Batroun (Hamat), two in Chouf (Mazraet el Nahr), two in Hasbaya (Hasbaya), one in Tyr (Deir Anoun) and one in Qaa (Chalak *et al*., 2012). Samples of adult female of *Dactylopius* were collected from each infected site and conserved separately in 70% ethanol for the identification. All the sites were geographically coordinated by using a Global Positioning System in order to develop a map of distribution of the new invasive pest and the level of infestation on *O. ficus-indica*. Interviews with local people were also conducted to collect additional information. The sites were classified into four categories according to the percentage of the surface of *Opuntia* cladodes infected by *Dactylopius* as following: 1) no infection; 2) low infection with less than 25% of the pad surface infected; 3) medium infection with 25-50% of the pad surface infected; 4) high infection with more than 50% of the pad surface infected.

Results

Specimens collected from all the infected areas were identified in the laboratory of entomology at LARI as *Dactylopius opuntiae* (Cockerell, 1896) according to De Lotto (1974) and Perez-Guerra & Kosztarab (1992). The adult female is oval in shape and measures 2.1-2.3 mm long and 1.4-1.7 mm wide; however the female is sub-globular on slide and measures between 2.0-3.1 mm long and 1.8-2.7 mm wide. *D. opuntiae* is reported in South Africa, Mauritius, Madagascar, United States of America, Sri Lanka, Reunion, Mexico, Brazil, Australia, Jamaica, India, Hawaiian Islands, Kenya, Pakistan (Ben-Dov & Miller, 2015). In the Mediterranean region, it is recorded only from France on ornamental cactus (Foldi, 2001), Israel on *O. ficus-indica* (Spodek *et al*., 2014), Morocco on *O. ficus-indica* (Bouharoud *et al*., 2016) and here we record it for the first time in Lebanon.

The survey showed that 55 of 90 sites were infested by *D. opuntiae* (table I). The distribution area of this scale was limited to the south of Lebanon from the coastal area to an elevation of 1047 m of altitude at Kaitouli village in the Jezzine District (fig. 1). The highest level of population was concentrated in the southern border, causing significant damages leading to the

Table I. – Distribution of *Dactylopius opuntiae* (Cockerell) and level of infection on *Opuntia ficus-indica* (L.) Mill. in Lebanon (* new infestation of *D. opuntiae* detected in 2015).

District	Number of sites	Number of sites infested by *D. opuntiae*	Level of infection
Batroun	2	–	–
Jbeil	7	–	–
Keserwan	3	–	–
Metn	1	–	–
Chouf	9	1*	Moderate
Sidon	4	–	–
Jezzine	8	1*	Moderate
West Bekaa	1	–	–
Rachaya	2	–	–
Hasbaya	13	13	Low - Moderate
Nabatieh	20	20	High
Tyre	13	13	High
Beint Jbeil	7	7	High
Total	**90**	**55**	

death of the whole plants. However, during summer 2015, infestation appeared in new sites in Jezzine and Chouf Districts. During the interviews with local people, some wrong practices were noticed, where some farmers cut the infected parts of the cactus and threw them away to get rid of the problem, while others used them as hedges for their lands.

Few numbers of the predator *Cryptolaemus montrouzieri* Mulsant, 1850 (Coleoptera, Coccinellidae) were observed in many sites in association with the population of *Dactylopius*. Only one site of infected cactus with a high population of *C. montrouzieri* was detected at the village of Kfardounin located at the southern border of the country.

Discussion

The cochineal *Dactylopius opuntiae* was introduced accidentally to Lebanon in 2012 in the region of Nabatieh and it is well established in the south of the country in different ecosystems ranging from 0 to 1000 m above sea level where the specific host *Opuntia ficus-indica* is growing. The fast spreading of the insects within a short period of time is the result of biotic and abiotic factors such as the ability of this species to reproduce by parthenogenesis (Flores-Hermendez *et al*., 2006), the absence of natural enemies, the tolerance to environment variation and the availability of source of nutrients.

The high level of infestation and the rapid spread of the cochineal in the districts of Nabatieh, Hasbaya, Beint Jbeil and Tyre in the southern regions were done mechanically by the local farmers due to negligence and lack of scientific knowledge of the biology and behavior of the insect. The progressive transition in the levels of infestation from high to moderate, then to low, is oriented from the South to the North, indicating that the insect has disseminated naturally. According to Moran & Cobby (1979), only the first instars known as “crawlers” are mobile and they climb up to the top of the cladodes from where they disperse to other cacti plants by wind.

The presence of the predator *C. montrouzieri* in small numbers cannot alone control the population of *D. opuntiae* due to the ability of the pest to reproduce by parthenogenesis. A national strategy for management of *Dactylopius opuntiae* should be implemented based on the map of the levels of infestation (fig. 1).

Conclusion

The impact of *D. opuntiae* on *O. ficus-indica* was obviously catastrophic in the South where all the plants were completely destroyed. This impact affected negatively the socio-economic level of the farmers who depend on Barbary fig production to increase their incomes. The lack

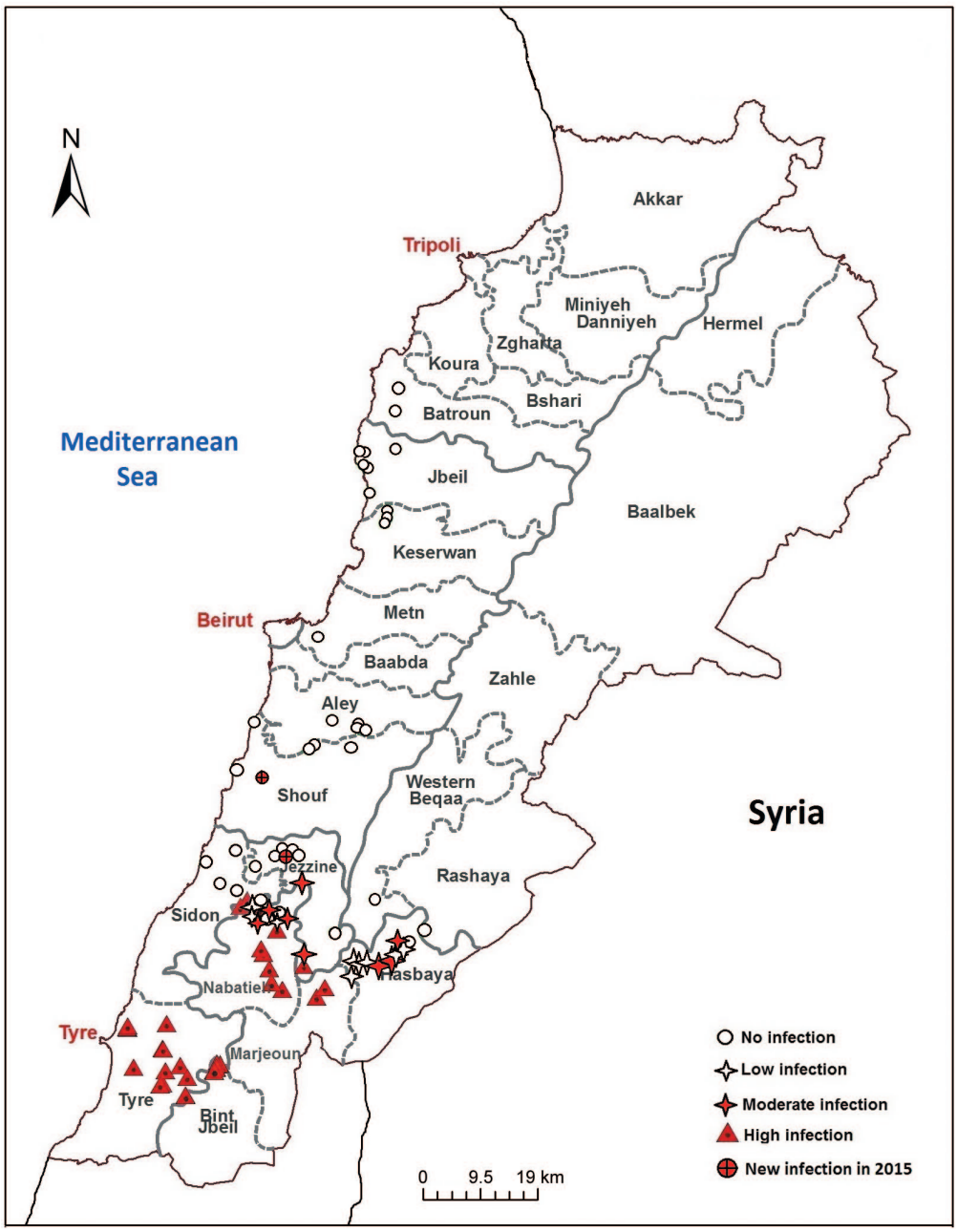

Fig. 1. – Map of distribution of *Dactylopius opuntiae* (Cockerell) in Lebanon and level of infestation on *Opuntia ficus-indica* (L.) Mill. for 2014 and 2015.

of awareness among farmers was the primary cause of increasing the outbreak of *D. opuntiae* in southern Lebanon. The risk of introduction of this pest to new areas is very high. Indeed, this new invasive pest has become a big concern for the prickly pear production in Lebanon and an eradication program should be implemented.

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