UF IFAS Extension UNIVERSITY of FLORIDA

UF/IFAS PEER REVIEWED EENY-807

https://doi.org/10.32473/edis-IN1420-2024

Leptomastix dactylopii Howard (Hymenoptera: Encyrtidae): parasitoid of mealybugs (Hemiptera: Pseudococcidae)[1]

Salman Al-Shami and Jawwad A. Qureshi[2]

The Featured Creatures collection provides in-depth profiles of insects, nematodes, arachnids and other organisms relevant to Florida. These profiles are intended for the use of interested laypersons with some knowledge of biology as well as academic audiences.

This publication describes the biology, distribution, behavior, and impact of the parasitoid *Leptomastix dactylopii* Howard. This beneficial insect is known for providing significant reductions in mealybug populations in Florida and other locations. This document is also intended to provide knowledge about this parasitoid to a wide range of interested audiences including growers, Extension agents, researchers, students, laypersons, and other stakeholders.

Introduction

Mealybugs are a unique group of scale insects in the family Pseudococcidae and are reported as serious pests attacking citrus in Florida (Diepenbrock et al. 2022). Application of insecticides does not always have a favorable outcome in mealybug control programs due to their presence and feeding in the concealed locations, a waxy covering on their bodies, and resistance to insecticides (Diepenbrock et al. 2022). The solitary endoparasitoid *Leptomastix dactylopii* Howard (Hymenoptera: Encyrtidae) is a beneficial insect that targets approximately 20 species of mealybugs (Hemiptera: Pseudococcidae) (Noyes and Hayat 1994; Chong and Oetting 2007).

Distribution

There are about 35 described species of the genus *Leptomastix* worldwide (Anga and Noyes, 1999). *Leptomastix dactylopii* is thought to be native to South America and Africa (Bartlett 1978; Anga and Noyes, 1999) but later spread around the world (Figure 1). It has been frequently used as a biocontrol agent against mealybugs in the Middle East, Europe, United States, Pakistan, India, and Australia (Smith et al. 1988; Noyes and Hayat 1994; Cocco et al. 2021; Muştu et al. 2022).

Description

Eggs

Females (Figure 2) lay only one egg per host individual (Yang and Sadof 1997; Marras et al. 2016) and prefer large size hosts including third and fourth instar nymphs (de Jong and van Alphen 1989; Muştu et al. 2022). Upon finding a suitable host, a female exhibits the behavior of examination, probing and oviposition (Chong and Oetting 2007). Interestingly, *Leptomastix dactylopii* is capable of

1. This document is EENY-807, one of a series of the Entomology and Nematology Department, UF/IFAS Extension. Original publication date February 2024. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication. This document is also available on the Featured Creatures website at http://entomology.ifas.ufl.edu/creatures.

2. Salman A. Al-Shami, postdoctoral researcher, and Jawwad A. Qureshi, associate professor; Entomology and Nematology Department, UF/IFAS Southwest Florida Research and Education Center; UF/IFAS Indian River REC; UF/IFAS Extension, Gainesville, Florida 32611.

distinguishing between unparasitized and parasitized hosts (Marras et al. 2016). A female *Leptomastix dactylopii* can lay up to 10 eggs a day (de Jong and van Alphen 1989) and about 51-66 eggs during her life span (Van Baaren and Nénon 1994; Yang and Sadof 1997). They fail to lay eggs in cold conditions and reproduce remarkably high at 26-30°C (78.8 - 86°F) (Tingle and Copland 1989; Battaglia and Tranfaglia 1994). There is a coating of spherulae containing a minute protein on the egg of *Leptoamstix dactylopii* that is believed to prevent its encapsulation by the host (Blumberg and Van Driesche 2001).

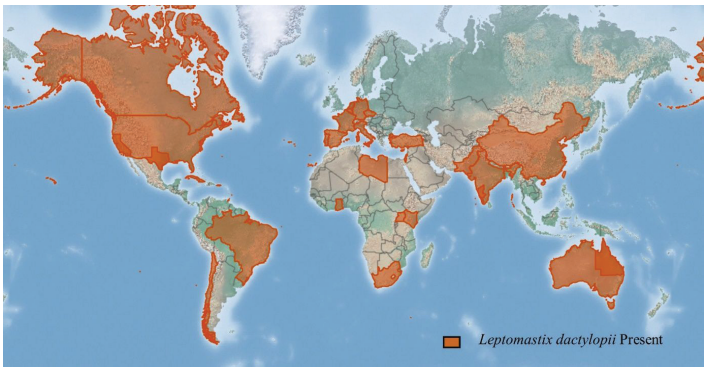

Figure 1. Global distribution of *Leptomastix dactylopii* Howard. Map from CABI 2022. Invasive Species Compendium. Wallingford, UK: CAB International.
Credits: https://www.cabi.org/isc/datasheet/31522#toDistributionMaps

Figure 2. Female of *Leptomastix dactylopii* laying eggs on mealybugs.
Credits: https://www.biocontrol.ch/fr_bc/leptomastix-dactylopii

Larvae

The mealybugs parasitized with *Leptomastix dactylopii* immediately stop feeding and never lay eggs (Zinna 1960). There are four larval instars of *Leptomastix dactylopii* and all feed and develop inside the host mealybug (Zinna 1960). The number of larval segments varies from 11 to 13, the last four segments are not clearly distinguished in the younger instars (Zinna 1960; Anga and Noyes 1999). Parasitized mealybugs turn brown in color and their bodies become bloated (Figure 3 top row). Muştu et al. (2022) reported that *Leptomastix dactylopii* female and male developmental time (egg to adult) is 16 and 15 days, respectively, when developing in third instar nymphs and 17 and 16 days, respectively, when developing in females of *Planococcus ficus*. Battaglia et al. (1996) reported a developmental duration for female and male *Leptomastix dactylopii* at 18 and 16 days, respectively.

Figure 3. Different immature stages of *Leptomastix dactylopii* developing in citrus mealybug *Planococcus citri*. Larvae (top row), Pupa (bottom row). The mummified mealybug was opened to show parasitoid pupa (bottom right dorsal view).
Credits: Salman Al-Shami UF/IFAS

Pupae

The larvae develop into pupae inside the mealybug. The color of the mealybug with *Leptomastix dactylopii* pupating inside is brown to dark brown (Figure 3 bottom row).

Adults

Leptomastix dactylopii adults emerge by chewing an exit hole in the mummified mealybug (Figure 4 top row). The wasp completes its life cycle in the host within approximately 3-4 weeks depending on the temperature and size of mealybug (Muştu et al. 2022). At 25°C (77°F), *Leptomastix dactylopii* can complete a generation in 16-18 days (Battaglia et al. 1996). According to Muştu et al. (2022), the total life span of parasitoid females and males in *Plancoccous citri* or *Plancoccus ficus* averaged 41 and 38 days, respectively. The adult is small {2–3 mm (~⅛ in)}, yellowish brown, and distinguishable by its long antennae which are darker in color and almost same length as the body (Anga and Noyes 1999). Females have bended antennae (Figure 4 bottom left), while males do not (Figure 4 bottom right). The adult can live for 2–3 weeks feeding on honeydew secreted by the mealybugs, nectar, and pollen.

Figure 4. Emergence hole of *Leptomastix dactylopii* adults in citrus mealybug *Planococcus citri* (top row). Adults of *Leptomastix dactylopii* female (bottom left) and male (bottom right).
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Hosts

Leptomastix dactylopii is an endoparasite of more than 20 mealybug species (Hemiptera: Pseudococcidae) including *Ferrisia virgata* (Cockerell), *Phenacoccus madeirensis* Green, *Phenacoccussolani* Ferris, *Planococcus citri* (Risso), *Pseudococcus longispinus* (Targioni-Tozzetti), *Planococcus ficus* and *Pseudococcus viburni* (Signoret) (Noyes and Hayat 1994; Chong and Oetting 2007). Several studies reported citrus mealybug *Planococcus citri*, vine mealybug *Pseudococcus ficus*, longtailed mealybug *Pseudococcus longispinus* and obscure mealybug *Pseudococcus viburni* as preferred hosts for this wasp (Mani et al. 2004; Chong and Oetting 2007; Mahfoudhi and Dhouibi 2009; Marras et al. 2016).

Biology and Ecology

Leptomastix species are primary, solitary endoparasitoids of mealybugs (Zinna 1959). *Leptoamstix dactylopii* progeny are dominated by females (Su and Li 1993). Survival is affected by several factors including food availability and temperature. This wasp is highly susceptible to low temperatures and lacks the ability for long overwintering (Franco et al. 2004; Mahfoudhi and Dhouibi 2009). According to Zinna (1960), the females of this parasitoid failed to lay eggs at temperatures lower than 18°C (64.4°F). At an average temperature of 27°C (80.6°F), females oviposited within a few hours after emergence (Lloyd 1958) and lived for a long time (Tingle and Copland 1989). *Leptoamstix dactylopii* is reported to target several species of mealybugs and shows a preference for some of the species known as significant agricultural pests such as citrus mealybug *Planococcus citri*, vine mealybug *Planococcus ficus*, longtailed mealybug *Pseudococcus longispinus* and obscure mealybug *Pseudococcus viburni* (Chong and Oetting 2007; Mahfoudhi and Dhouibi 2009).

Biological Control Agent Importance

Leptomastix dactypolii has been used to control the citrus mealybug *Plancococcus citri* and vine mealybug *Pseudococcus ficus* populations in fields and greenhouses (Doutt 1952; Krishnamoorthy and Singh 1987; Smith et al. 1988; Mani et al. 2011). In California, *Leptomastix dactylopii* has been used effectively to suppress vine mealybug *Plancococcus ficus* populations (Daane et al., 2008, 2012) and has been frequently found in vineyards of South Africa and Tunisia (Walton and Pringle 2004; Mahfoudhi and Dhouibi 2009). Krambias and Kontzonis (1980) reported a parasitism rate of 16% on citrus mealybug by *Leptomastix dactypolii* in Cyprus. In India, establishment of this parasitoid in two orchards resulted in successful control of citrus mealybug in 3-4 months (Krishnamoorthy and Singh 1987). *Leptomastix dactypolii* was also responsible for the significant reduction of citrus mealybug populations in Citrus Under Protective Screen (CUPS) in the Southeast of Florida (Al-Shami and Qureshi, unpublished). It is available commercially and can be an ideal biological control agent against citrus and vine mealybugs. This will help growers to control these mealybugs attacking crops in small nurseries and greenhouses or even at a larger scale in orchards. There is no information on the efficacy of *Leptomastix dactypolii* against the newly spreading lebbeck mealybug, *Nipaecoccus viridis* in citrus crops in Florida. Future investigation on the suitability of *Leptomastix dactylopii* to control the lebbeck mealybug will make a worthwhile contribution to current citrus IPM programs.

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