Symptomatology of Infestation by Hypogeococcus pungens: Contrasts between Host Species

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INTRODUCTION

During the past 30 to 40 years, invasive cactus species within the genus Harrisia in Australia and South Africa have been successfully controlled and sometimes eradicated using the Hemiptera Hypogeococcus pungens, Granara de Willink (1981), the Harrisia cactus mealybug (HCM) (McFadyen & Tomley 1978, 1980, White & Donnelly, 1993, and Paterson et al, 2011). This pseudococcid used to be mis-classified as its close relative H. festerianus (Zimmermann et al, 2010b), but was later identified as a different species due to small morphological differences and different host plant range (Granara de Willink, 1981). As for its biology, almost nothing has been published, aside from its success as a biocontrol agent for alien cactus weeds (White & Donnelly, 1993, Paterson et al, 2011) and acknowledging HCM as a menace to native and endemic cacti of Central and North America and the Caribbean (Zimmermann et al, 2010a, b).

HCM infestations were first sighted in Puerto Rico during 2003 and identified in 2005 (Segarra-Cardona & Rodriguez-Lluch, 2007), but how it was introduced to the island is still unknown. Originally native to the arid zones of Argentina (Granara de Willink, 1981), the insect now affects seven of the fourteen native cactus species occurring in dry forests of the island, including endemic species (Carrera-Martínez et al, unpublished data: this article). Three of these species (Pilosocereus royenii, Harrisia portoricensis and Stenocereus fimbriatus) are columnar cacti, while another three (Leptocereus quadricostatus, L. grantianus, and Hylocereus trigonus) are semi-epiphytic, and Melocactus intortus has a globular morphology typical for its genus. Of these species, L. grantianus and L. quadricostatus are endangered and federally protected (Gann & Taylor 2013; Taylor 2013).

The infestation is normally diagnosed by the presence of galls around the cactus’s trunk and stems. An in depth description of symptom manifestation has not been published. Since the seven cactus species hosting HCM in Puerto Rico have different morphologies and belong to different tribes, differences in symptomatology associated with the infestation of H. pungens are expected. The goal of this project is to provide detailed descriptions of the HCM infestation symptoms for each cactus species, with detailed morphological descriptions of the galls.

Abstract: The Harrisia cactus mealybug (HCM), Hypogeococcus pungens (Hemiptera: Pseudococcidae), is known to be an effective biological control agent for invasive columnar cacti in Australia and South Africa. In the Caribbean, Central and North America, HCM is an alien invasive species that is threatening native cactus. Despite their negative impacts on ecosystems where cacti are native, no publications have described the symptomatology associated with HCM infestation. This article describes the morphology of the galls produced by HCM on seven host cactus species occurring in Puerto Rico.

Keywords: Hypogeococcus pungens, Harrisia Cactus Mealybug, Puerto Rico, biological invasion, Pilosocereus royenii, symptomatology
Figure 1. V-shaped growing scars on an infested stem of Pilosocereus royenii.

Figure 2. Chlorosis and multiple stems growing from Pilosocereus royenii due to infestation by Harrisia Cactus Mealybug, Hypogeococcus pungens.

Figure 3. Symptoms associated with Harrisia Cactus Mealybug, Hypogeococcus pungens, infestation on Pilosocereus royenii: deformed flowers growing from the galls.
METHODS

About 368 infected specimens of Pilosocereus royenii, 84 Melocactus intortus, nine Leptocereus quadricostatus, ten L. grantianus, six Stenocereus fimbriatus, four Hylocereus trigonus and a single Harrisia portoricensis where used to observe the symptoms associated with the infestation. All the cacti surveyed were located within 11 sites around the southwest coast of Puerto Rico. The survey was conducted over two years. In the case of L. grantianus, all individuals studied were at the USFW greenhouse located in the agency headquarters in Cabo Rojo, growing in pots and not in their natural habitat on the island of Culebra. These individuals were infected naturally, as the adults of HCM are small enough to pass through the fabrics covering the greenhouse. The presence of individuals of HCM was confirmed by morphological identification under the dissection microscope (as direct proof) and by the presence of a white waxy material on the galls (as indirect proof). The presence of the waxy substance on the galls is considered efficient to determine its infestation, since it is the only known pest associated with both galls and a waxy substance affecting cacti in Puerto Rico. Others members of this genus have not been reported on the island.

RESULTS AND DISCUSSION

All galls showed direct or indirect presence of adult female HCM. Galls on P. royenii, H. portoricensis and S. fimbriatus had similar morphology (see Figs 1–4 for galls in P. royenii). The galls appeared to be covered by trichomes and localized near the apical shoot of the stems or branches. Most branches of P. royenii had thick v-shaped growing scars when the infestation was severe (Fig. 1). Development of new branches from apparent old galls was observed (Figs. 1 & 2). Some galls on P. royenii and on S. fimbriatus developed deformed flowers and fruits (Figs. 3 & 4). The flowers on these galls usually lack pistils, and so are usually sterile. Sometimes these gall-growing fruits developed without seeds. In some cases, branches of P. royenii with galls had signs of chlorosis (Fig. 2) and necrosis. The deformed flowers and fruits growing from galls, and the growing scars were not observed on S. fimbriatus, maybe due to low rates of infestation and reduced gall size. Sometimes, white waxy substances could be observed protruding from the galls (Fig. 3).

Although similar galls were observed in Melocactus intortus, a higher variance was observed in morphology (Figs. 5 & 6). These galls were normally located on the base of or on the cephalium of the adult M. intortus (Fig. 5). Juvenile M. intortus were not infected as frequently as the adults. Infected juveniles could be completely covered by small branches, similarly to the old galls in P. royenii (Fig. 6). Galls in adult M. intortus developed a series of smaller branches and inflorescences, or developed deformities on the original inflorescence.

In the case of Leptocereus quadricostatus, L. grantianus and H. trigonus, galls did not develop trichomes (Figs 7 & 8). Instead, galls always resembled a dense concentration of smaller deformed branches developing from the site of infestation by HCM. Because of this and the development of smaller branches on the infestation point in the others species, the term “gall” seems to be inappropriate to describe this abnormal growth. Future consideration on the nature and description of this abnormal growth is recommended. On these species, a white wax produced by the HCM is visible on galls without the need of dissection, probably due to the lack of trichomes. The development of deformed flowers on galls was only observed on specimens of infected L. grantianus.

Columnar cacti are known to function as key-
stone species as many others organisms depend on them for food and shelter (Valiente-Banuet et al, 1996, Fleming et al, 2001, Soriano & Ruiz, 2002, and Fagua & Ackerman, 2011). Many columnar cacti have a specialist relationship with bats, while Melocactus intortus developed a similar relationship with hummingbirds, depending solely on them for pollination and reproduction (Valiente-Banuet et al, 1996, Soriano & Ruiz, 2002, and Fagua & Ackerman, 2011). Currently, the effects of the invasion of HCM in Puerto Rico are not well understood, but expected to be severe (see Zimmermann et al, 2010a). A recent study indicates that HCM is present in all southwestern portions of the island, where most of the native dry forest is located (Carrera-Martínez et al, unpublished data). This same study also suggests that mortality is high in some species, particularly M. intortus, while others might be able to survive for a longer time. Another study suggests that the infestation of HCM in *E. royenii* changes the levels of many nutrients necessary for the optimal functioning of the plants (Aponte-Díaz et al, unpublished data). As these recent studies help to understand the ecology of HCM and its interaction with the Puerto Rican native cactus species, more questions arise and more research must be done.

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REFERENCES


