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Biology, oviposition preference and impact in quarantine of the petiole-galling weevil, *Coelocephalapion camarae* Kissinger, a promising candidate agent for biological control of *Lantana camara*

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Abstract

The petiole-galling weevil, *Coelocephalapion camarae* Kissinger (Coleoptera: Brentidae), native to Mexico, was introduced into quarantine in South Africa to evaluate its potential to supplement the biological control programme against the invasive varieties of *Lantana camara* L. (Verbenaceae). The weevil occurs over a wide, native, geographic range, indicating its physiological potential to establish and persist throughout the range of climatic conditions under which the target weed grows in South Africa. The adults are highly selective in their choice of oviposition site, and only leaf-petioles with a width larger than 1.5 mm are accepted. Emerging larvae burrow into the vascular tissue and induce gall formation. Galling disrupts the transport of water and nutrients to and from the leaf, causing it to desiccate. During glasshouse studies the effect of galling on plant growth was tested on two different lantana varieties. The apionine both reduced lantana biomass accumulation (from 2 to 43% dry mass), and altered subsequent resource allocation away from the roots in both lantana varieties. Root growth increment loss over the duration of the trials on medium-density beetle-colonized plants (10 adult pairs) was between 109 and 144%, and increased from 109 to 117% in high-density beetle-colonized plants (20 adult pairs). These studies suggest that *C. camarae* could make a valuable contribution to the biocontrol programme against *L. camara*, and that studies on its host specificity are warranted.

Keywords: Coelocephalapion camarae; Coleoptera; Brentidae; Apioninae; Lantana camara; Verbenaceae; Pre-release studies; Gall formation; Impact assessment; South Africa

1. Introduction

The invasive alien plant, *Lantana camara* L. (Verbenaceae), has been the target of a biological control programme in South Africa since 1960 but still flourishes and requires supplementary control interventions (Cilliers and Neser, 1991; Baars and Neser, 1999; Baars, 2003; Baars and Heystek, 2003). Some additional candidate agents recently evaluated in quarantine proved insufficiently host-specific for release into Africa (Heystek and Baars, 2005; Mabuda, 2005; Phenye and Simelane, 2005; Williams and Duckett, 2005), whilst others that were suitable (Simelane, 2002; Baars et al., 2003; Den Breeÿen and Morris, 2003) have had geographically limited impacts, indicating a persisting need for new agents that promise sustained and widespread suppression of the target weed.

Some apionine weevils have proven to be effective weed biocontrol agents, notably *Trichapion lativentre* (Beguin-Billecocq) in the seed-pods of *Sesbania punicea* (Cav.) Benth. in South Africa, *Coelocephalapion pigrae* Kissinger in the inflorescences of *Mimosa pigra* L. in Australia, *Perapion antiquum* (Gyllenhal) in the stems of *Emex australis* Steinh. above 600 m in Hawaii, *Apion fuscirostre* (Fab.) in the seed-pods of *Cytisus scoparius* L. in western USA, and *Omphalapion hooker*

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Kirby in the seed-heads of *Tripleurospermum inodorum* (L.) Schultz Bip. in Canada (Julien and Griffiths, 1998). The first biocontrol agents released on *Lantana camara* in Hawaii in 1902 included two apionines, listed as *Apion* sp. A and *Apion* sp. B, from Mexico (Perkins and Swezey, 1924), but they did not establish (Gardner and Davis, 1982). Further surveys of phytophages on *Lantana* spp. in Mexico yielded *Coelocephalapion* sp. nr. *fusciventre* (Palmer and Pullen, 1995), but it was rare and not considered promising. Subsequent collections included an apionine that was described as *Coelocephalapion camarae* (Coleoptera: Brentidae) (Kissinger, 2000), and during its evaluation as a candidate biocontrol agent for *Lantana camara* in South Africa, it was found to be a leaf-petiole galler.

The success of endophagous insect agents on some other South African weeds (Hoffmann and Moran, 1999) supports the selection of endophagous candidate agents for *L. camara*, although some leaf miners, like *Calycomyza lantanae* (Frick) and *Octotoma scabripennis* Guérin-Méneville have not provided sufficient stress on lantana (Baars and Heystek, 2003). In particular, gall-inducing agents have been successful in some biocontrol programmes, particularly when the gall acts as a metabolic sink (Dennill, 1988; Harris and Shorthouse, 1996). In addition, the close association of gall inducers with their hosts implies a narrow host range (Forno et al., 1994; Harris and Shorthouse, 1996), reducing the risk of non-target effects.

In this paper, we describe the life history, gall characteristics and damage caused by the weevil, in an attempt to predict the contribution that *C. camarae* may make to biological control of *L. camara*.

2. Materials and methods

Coelocephalapion camarae was collected from a *Lantana* species, probably *L. camara* (S. Neser, personal communication) at Cárdenas (Tabasco Province, Mexico) during a survey in October 1997. This apionine weevil was cultured in the quarantine laboratories and glasshouses of the Plant Protection Research Institute (Pretoria, South Africa), where life history and impact studies were conducted. Laboratory cultures were maintained at 21–28 °C, 60–70% RH and a 13 h photoperiod. The glasshouse studies were subject to temperatures of 20–30 °C and a natural summer photoperiod of about 14 h.

Reference plants were made from cuttings from eight different *L. camara* varieties naturalised in South Africa. These varieties were selected to represent the range of morphological variation present in South Africa, notably of growth form, leaf characteristics, leaf-petiole size, shoot tip characteristics and flower colour (Table 1). All test plants were propagated under 50% shade net, with overhead irrigation, and grown in a standard growing medium of loam, coarse river sand and compost.

The results from trials described below were analysed using an ANOVA and Fisher's Protected LSD at the 5% level (Genstat 5, 1993), unless otherwise specified.

2.1. Native distribution and field status

A limited field survey was conducted in Mexico to determine the distribution patterns of *C. camarae*. Thirty-six sites were sampled along the gulf coast, from Merida (Yucatan Province) to Tampico (Veracruz Province) in October 1998. Sites were selected where *L. camara* plants were common, with at least 10 plants occurring in close proximity to each other. The habitats sampled included roadsides, stream banks, boundaries of farmlands and natural vegetation. At each site, at least 10 plants were sampled, and two to three sections of each plant were shaken above a beating tray to dislodge the weevils for collection. To quantify gall development, the available leaf-petiole

Table 1
Origin and key characteristic descriptions of the *L. camara* varieties from South Africa used during trials, selected as reference plants representing the major weed varieties growing as extensive field infestations

Lantana camara Variety	Origin: town/province	Grid reference	Distinguishing morphological characteristics	Flower colour[a]
009	Sycamore Mpumalanga	25°35′13.7″S 30°27′08.5″E	Spiny and hairy shoot tips; leaves hairy; main stem with few spines	Light-pink
012	Sycamore Mpumalanga	25°35′13.7″S 30°27′08.5″E	Shoot tip very spiny; leaves small and hairy; main stem very spiny	Light-pink
015	Kiepersol Mpumalanga	25°02′21.6″S 31°02′19.8″E	Shoot tip spiny; large broad dark hairy leaves; main stem spiny	White
017	Sabie east Mpumalanga	25°03′17.1″S 30°57′03.6″E	Shoot tip hairy, spiny and reddish in colour; leaves hairy and small; hairy main stem with few spines	Orange-reddish pink
018	Sabie Mpumalanga	25°07′04.9″S 30°45′39.2″E	Shoot tip spiny; leaves large, thick and tough; main stem spiny	Dark-pink
029	Hazyview Mpumalanga	25°08′10.6″S 30°00′09.0″E	Shoot tip spiny; large broad dark hairy leaves; main stem spiny	White-pink
150	La Mercy KwaZulu- Natal	29°38′45.9″S 31°07′39.5″E	Scrambling shrub; shoot tips hairy, spiny and reddish in colour; leaves small and hairy	Orange
163	Scottburgh KwaZulu- Natal	30°09′08.4″S 30°49′39.7″E	Spiny and hairy shoot tips; leaves hairy; main stem with few spines	Light-pink

[a] Colour of mature flowers.