Field efficacy of imidacloprid and *Steinernema carpocapsae* in a chitosan formulation against the red palm weevil *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) in *Phoenix canariensis*

Óscar Dembilio,a,b Elena Llacer,a,b María del Mar Martínez de Altube and Josep A Jacas,a,d*

Abstract

BACKGROUND: The invasive red palm weevil, *Rhynchophorus ferrugineus* (Olivier), has become the major pest of palms in the Mediterranean Basin. Chemical control against this species is difficult because of its cryptic habits and is mainly based on the repeated application of large quantities of synthetic insecticides. The aim of this work has been to evaluate in the field the efficacy of imidacloprid (Confidor® 240 OD) and *Steinernema carpocapsae* Weiser with chitosan (Biorend R® Palmeras) as soil and stipe treatments respectively, alone or in combination, against this pest.

RESULTS: All treatments significantly reduced the mean number of immature stages of *R. ferrugineus* per palm. However, there were no significant differences among the different treatments considered. Efficacies ranged from 83.8 to 99.7% for the mean number of immature stages found in the palms and resulted in a significant increase in palm survival compared with the untreated control (75.0–90.0% versus 16.5% respectively).

CONCLUSION: Both imidacloprid and *S. carpocapsae* in a chitosan formulation proved highly effective against *R. ferrugineus* in the field, and their efficacies did not significantly change when used in combination.

Keywords: mortality; *Phoenix canariensis*; *Rhynchophorus ferrugineus*; imidacloprid; *Steinernema carpocapse*; chitosan

1 INTRODUCTION

The invasive red palm weevil, *Rhynchophorus ferrugineus* (Olivier) (Coleoptera: Curculionidae), has become the major pest of palms in the Mediterranean Basin, where it spread slowly during the mid-1990s and very quickly during the last 5 years. The pest is currently widely distributed in Oceania, Asia, Africa and Europe1 and has been recently found in the Caribbean.2 Females lay their eggs at the base of the fronds in separate holes made with their rostrum. Neonate larvae bore into the palm core and, on completion of development, move back to the base of the fronds to pupate. A new generation emerges, and these adults may remain within the same host and reproduce until the palm eventually dies. Subsequently, adults will move and look for a new palm host. *Rhynchophorus ferrugineus* has been reported on 19 palm species belonging to 15 different genera.1,3,4 Several control methods have been applied against this pest within an integrated pest management strategy. Its main components are phytosanitation, which involves cutting down and burning infested palms, use of insecticides and use of pheromone traps for adult monitoring and mass trapping.

Chemical control against *R. ferrugineus* is mainly based on the repeated application of large quantities of synthetic insecticides, which are applied in a range of preventive and curative procedures designed to limit and contain the spread of infestation. These procedures have been developed and refined since commencing in India in the 1970s.5 Methods range from general dusting of the leaf axils, after pruning or spraying of the palm stipe, to localised direct injections of chemicals into the trunk.6 Researchers have...