

Screening of entomopathogenic fungi against citrus mealybug, *Planococcus citri* (Hemiptera: Pseudococcidae)

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Planococcus citri (citrus mealybug) is a common and damaging citrus crop pest which has proven difficult to control using conventional methods, such as chemical pesticides and insect growth regulators, particularly late in the citrus growing season. The virulence of two entomopathogenic fungal species was studied in laboratory bioassays against the crawlers and adults of *P. citri*. Isolates of *Metarhizium anisopliae* and *Beauveria bassiana*, collected from citrus orchards in the Eastern Cape Province in South Africa, were verified using molecular techniques. Mealybug bioassays were performed in 24-well plates. *Beauveria bassiana* (GAR 17 B3) and *M. anisopliae* (FCM AR 23 B3) isolates both resulted in 67.5 % mortality of mealybug crawlers and *B. bassiana* (GB AR 23 13 3) resulted in 64 % crawler mortality with concentrations of 1×10^7 conidia/ml. These three isolates were further tested in multiple-dose bioassays to determine the median lethal concentration (LC₅₀), which were 5.29×10^5 conidia/ml for the *M. anisopliae* isolate (FCM AR 23 B3), 4.25×10^6 conidia/ml for *B. bassiana* (GAR 17 B3), and 6.65×10^7 conidia/ml *B. bassiana* (GB AR 23 13 3) for crawlers, respectively. The results of this study suggested the two isolates (*M. anisopliae* FCM AR 23 B3 and *B. bassiana* GAR 17 B3) showed potential for further development as biological control agents against citrus mealybug. Further research would be required to determine their ability to perform under field conditions.

Key words: *Metarhizium anisopliae*, *Beauveria bassiana*, biological control, mycoinsecticide, bioassay.

INTRODUCTION

Mealybugs (Hemiptera: Pseudococcidae) are well known crop pests which feed on a variety of fruit and ornamental crops (Wakgari & Giliomee 2003). There are over 60 different mealybug species documented on citrus plants alone (Hattingh *et al.* 1998; Franco *et al.* 2004). Many mealybug species are cosmopolitan pests and are found widely distributed throughout the world (Krishnamoorthy & Singh 1987; Gullan 2000; Wakgari & Giliomee 2003; Franco *et al.* 2004). In South Africa seven mealybug species have been recorded as either pests or potential pests on citrus (Wakgari & Giliomee 2003; Pieterse *et al.* 2010).

This study focused on the highly polyphagous and damaging *Planococcus citri* (Risso) (Hemiptera: Pseudococcidae), which has the ability to rapidly increase its population size and dominate its habitat, along with displacing other mealybug species which could be sharing its ecological niche (Wakgari & Giliomee 2003). On citrus in South Africa mealybugs are considered as key pests, with many farm-

ers applying a minimum of one control measure in any given season (Hattingh *et al.* 1998). They also produce large amounts of honeydew, which increases the growth of sooty mould. These mould colonies comprise many different species (Phylum: Ascomycota) (Chomnunti *et al.* 2014) and decreases the photosynthetic potential of the plant and if not washed off reduces quality and prevents the fruit from being exported (Hattingh *et al.* 1998; Demirci *et al.* 2011). *Planococcus citri* crawlers are highly motile, in comparison to adult females which become sedentary, especially after ovipositing. The crawlers feed by sucking plant sap from succulent plant tissues and thus, can heavily affect areas of new growth and young fruit development. Their preferred feeding sites are on developing fruits below calyxes and inside navel openings, on Navel oranges, as well as contact areas between two or more fruit, on twigs and below the petioles of leaves, although populations can be found anywhere on the trees (Hattingh *et al.* 1998; Demirci *et al.* 2015).

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