

PATOGENICITY OF *METARHIZIUM ANISOPLIAE* AND *BEAUVERIA BASSIANA* TO THE AMERICAN COCKROACH (DICTYOPTERA: BLATTIDAE)

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Abstract The entomopathogenic fungus *Beauveria bassiana* Vuillemin 1912 and *Metarhizium anisopliae* (Metschnikoff) Sorokin 1976 were tested against *Periplaneta americana* cockroach under laboratory conditions (1.1 x 10⁶ conidia/cockroach, 24 ± 2°C and 50 ± 10% RH). The isolates tested against nymphs and adults of *P. americana* showed low pathogenic potential and significant mortality differences. Adults exhibited less mortality than nymphs, which showed behavioral changes once they received a conidial suspension. The two most virulent isolates were selected and tested on three representative age groups of *P. americana*. A second experiment evaluated if different mortality could exist in adult cockroach under controlled conditions (85 ± 10 % RH, 27°C). Cockroach adults were susceptible to infection by *M. anisopliae* and *B. bassiana*; under high relative humidity conditions these fungi caused more mortality (47%), compared with laboratory conditions (3%). Implications on the addition of these isolates to sublethal doses of boric acid are discussed.

Key Words *Periplaneta americana*, cockroach control

INTRODUCTION

The American cockroach, *Periplaneta americana*, is a very important urban pest distributed worldwide and usually is controlled using synthetic insecticides, and because of the insecticide resistance, alternative methods have been investigated, including biological control. Entomopathogenic fungi have been recommended since they are effective and present low risk for mammals and humans. Some of these fungi are *Metarhizium anisopliae* (Ascomycota: Hypocreales) and *Baeuveria bassiana* (Quesada et al., 2004) evaluated in nymphs and adults of *P. americana*.

MATERIALS AND METHODS

The pathogenicity of one isolate of *B. bassiana*, and four isolates of *M. anisopliae* spores were evaluated at ambient conditions (24± 2°C and HR 50±10%) in three age groups of the American cockroach (E1: nymphs 1-6 instars; E2: nymphs 7-12 instars; and adults). The isolates were growth in DSA medium during 15 days, and suspended in Tween 80 0.1% at 1.1x10⁸ spore/ml. Ten (10) microliters of the suspension was applied on the hind coxae to 20 cockroaches (1.1 x 10⁶ spores/insect). The control was treated with 10 µl of Tween 80 0.1%. The best treatments (*B. bassiana*, Bb88, and *M. anisopliae*, Destruxin) were evaluated at high humidity (HR 85±10%) on adults. Boric acid was added to fungi at rates that not affect the fungi germination (3, 5 and 7%) prepared as pellets and fed cockroaches. Data was analyzed using SAS for Windows V8. Mortality was transformed to (arcsin) . $\sqrt{\text{percentage}}$ Pathogenicity was analyzed using PROC ANOVA, and Tukey (P≤0.05).

RESULTS AND DISCUSSION

At ambient condition, nymphs are more susceptible to both fungi. In adults, mortality for *B. bassiana* and *M. anisopliae* was less than 10%. E1 treatment showed high mortality. It has been reported that dry ambients

are not favorable for the fungi development; however, the spores concentration could be another determinant factor. The age could be involved since it takes longer to first instar insects to develop the immune response (Boucias and Pendland, 1984).

When the best strains (Bb88, *B. bassiana*, and Dextruxin, *M. anisopliae*) were tested at 85% RH in adults, the mortality increased to 49±4.6% for *M. anisopliae*, and 44±6.1% for *B. bassiana*. Even when *M. anisopliae* is potentially effective to kill cockroaches, it takes longer compared with other insecticides. For this reason it has been suggested to mix it with other lethal agents to increase the toxicity (Thompson and Brandenburg, 2006).

The boric acid alone produced less than 5% of mortality in nymphs, probably because does not adhere to the cuticle (Gore and Schal, 2004); however the addition of boric acid to food attractants at sublethal doses to *B. bassiana* (Bb 88) had a synergic effect. The addition of boric acid at 3 and 5% to food and mixed with *B. bassiana* produced 82 and 92% of mortality, respectively, and has a good acceptance by the American cockroach. It has been reported that concentrations higher than 10% may have repellence in German cockroach.

CONCLUSIONS

The mortality produced using fungi alone is low to keep American roach populations under control. However, the addition of boric acid to *B. bassiana* and applied to nymphs at sublethal concentrations increases the mortality to 82% or more. These results may help to develop a specific bait that works in Mexican conditions against the American cockroach.

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