

## ABSTRACT

### Studies on the use of entomopathogenic fungi for the control of ticks on cattle

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A study was conducted to develop and evaluate a fungal entomopathogen-based biological pesticide for the direct control of ticks on cattle. Out of seven isolates obtained from the local population, none were found to be suitable for further development due to safety concerns and lack of pathogenicity (*Isaria tenuipes* and *Fusarium proliferatum*) to *Rhipicephalus microplus*. One promising isolate of *Metarhizium anisopliae* (ARSEF3297) was selected for further investigation based on data from a previous study. ARSEF3297 was found to be effective against all development stages in *R. microplus* and *Rhipicephalus sanguineus* except larvae of the latter but was also pathogenic to several non-target organisms (*Anagyrus kamali*, *Polistes* sp., *Callosobruchus maculatum*, *Maconellicoccus hirsutus* and *Coscineuta virens*). Pathogenicity of ARSEF3297 to *R. microplus* increased with increasing concentration of conidia up to  $5 \times 10^8$  conidia/ml. Formulation using paraffin based Emulsifiable Oil Adjuvants (EOAs) and pre-soaking of the biological pesticide in tap water also enhanced pathogenicity. In trials on cattle, ARSEF3297 did not reduce the tick population although low levels of sporulation were observed in ticks collected from ARSEF3297 treated cattle. The possible limitations of surface temperature, skin secretions and cattle hair to the performance of entomopathogenic fungi were then investigated. An isolate of *M. anisopliae* (IMI386697) known to be arachnopathogenic and tolerant

to relatively high temperatures was equally pathogenic to *R. microplus* as ARSEF3297 at 28 °C. However, IMI386697 was more pathogenic than ARSEF3297 when the temperature fluctuated from 31 – 35 °C reflecting the diurnal temperature variation of the escutcheon and udder in local cattle. In trials on cattle, IMI386697 reduced the tick population to a greater extent than ARSEF3297. Cattle sebum and urine were found to be detrimental to germination of IMI386697, sweat was found to be mildly promotive while no significant effects were observed for saliva. The levels of infection due to direct impaction on larvae on the cattle coat could not be determined; however, low levels of residual infection occurred on washed hair treated with IMI386697 in water and hair treated with IMI386687 in Cropspray. Residual infection is influenced by available conidia, persistence and initial infectivity. IMI386697 conidia formulated in water were more readily lost due to washing in water than conidia in EOAs or pure oils. Coconut oil was found to be detrimental to survival of IMI386697 in treated hair relative to water, EOAs and soybean oil. Recovery of IMI386697 colony forming units (CFU) from cattle declined with an approximate half life of 24 hours. Weekly sprays of IMI386697 on cattle reduced tick levels to a greater extent than bi-weekly application suggesting persistence may be limited on cattle under field conditions.

Key words: *Metarhizium anisopliae*, *Boophilus microplus*, *Rhipicephalus sanguineus*, biological control, biopesticide, cattle, Ixodidae, ticks.