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Evaluation of Entomopathogenic Fungi against *Psalmocharias alhageos* (Hemiptera: Cicadidae) under Laboratory and Semi-Field Conditions

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Abstract

The grapevine cicada, *Psalmocharias alhageos* (Kolenati) (Hemiptera: Cicadidae), has recently become a significant threat to grape vineyards in the Middle East. The nymphal stages of this species, dwelling in the soil, inflict considerable damage to the roots, exploiting their subterranean habitats to evade traditional control methods. Entomopathogenic fungi (EPFs) have shown promise in combating a wide range of soil-dwelling pests. Hence, we examined the effectiveness of three EPF species, *Beauveria bassiana* (Balsamo) Vuillemin 1912 (Hypocreales; Cordycipitaceae), *Beauveria varroae* Vuillemin 1912 (Hypocreales; Cordycipitaceae), and *Metarhizium anisopliae* (Metschnikoff) Sorokin (Hypocreales; Clavicipitaceae) against the grapevine cicada. In laboratory trials using petri dishes, *M. anisopliae* displayed the highest virulence, with an LC_{50} value of 1×10^6 conidia/ml, followed by *B. bassiana* with an LC_{50} of 7.2×10^6 conidia/ml. Cumulative mortality of *P. alhageos* was greater, and median survival time (MST) was shorter in soil column experiments compared to petri dish trials. At the highest tested concentration (1×10^8 conidia/ml), *M. anisopliae* exhibited the most significant efficacy against cicada nymphs, resulting in 75% cumulative mortality. Soil type significantly influenced the activity of *M. anisopliae* and *B. bassiana* against *P. alhageos*, with *M. anisopliae* causing higher nymph mortality in sandy loam and loam soil compared to clay loam. Additionally, MST was higher in clay loam soil than in the other soil types assessed. Temperature also impacted fungal pathogenicity, with higher cumulative mortality caused by *M. anisopliae* observed at 20°C than at 25 or 30°C. Moreover, MST increased as temperature decreased. Our assessments of pure EPF cultures suggest that these microbial agents could be valuable in managing *P. alhageos*. However, further research is necessary to investigate mass production and compatibility for integration with other control methods. Future large-scale evaluations of *M. anisopliae* under field conditions are imperative.

Keywords: Biocontrol, Insect pathology, Microbial control, Vineyard management