Eusocial Structure of *Macrotermes* Termites and Antagonistic Potential of Fungal Biocontrol Agents against *Termitomyces* Fungus and Termites

S. Kugatharshini[1]*, S. Sritharan[2], V. Jegathambigai[3], and G. Mikunthan[1]
[1]Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna, Sri Lanka
[2]Agriculture Farm, Faculty of Agriculture, University of Jaffna, Sri Lanka
[3]SPADO International Pvt. Ltd, Dankotuwa, Sri Lanka
*ttharsi66@gmail.com

The study was conducted to investigate the mutual relationship between *Macrotermes* termites and their symbiotic fungus *Termitomyces*, focusing on their structural organization and functional roles within the mound ecosystem. Additionally, the research explored the potential of using fungal antagonists as eco-friendly biocontrol agents for sustainable termite management. Field observations were conducted on ten *Macrotermes* mounds and detailed data were collected from only one representative mound, which was dome-shaped with multiple ventilation holes measuring 3–6 cm in diameter, an average height of 120 cm, and an average width of 190 cm. Internal examination revealed well-organized chambers containing fungus combs with a mean fresh weight of 230.47 ± 92 g, a perimeter of 37.5 ± 5 cm, and a volume of 1793.1 ± 926 cm^3, indicating advanced eusocial organization and efficient resource allocation. The isolated *Termitomyces* species displayed white, cottony mycelial growth with basidiomycete characteristics, including clamp connections observed microscopically. Dual culture assays with three replicates demonstrated strong antagonistic activity of *Trichoderma viride* against *Termitomyces*, achieving 83.33% inhibition of mycelial growth after 14 days. An eco-friendly substrate formulation containing tamarind seed and fenugreek seed supported maximum mycelial growth and sporulation ($6.23 \pm 0.3 \times 10^6$ spores g^{-1}) at an optimal pH range of 5.5–6.5. *T. viride* colonized sterilized termite combs more effectively than wild combs, suggesting that native microbial flora restricted colonization. Laboratory bioassays revealed a significant effect ($p < 0.05$) of entomopathogenic fungi on termite mortality, with *Paecilomyces cerevisiae* causing the highest mortality (85%), followed by *Metarhizium anisopliae* (75%) and *Beauveria bassiana* (49.3%). Overall, the findings support the use of fungal-based biocontrol agents in environmentally sustainable management of *Macrotermes* termites.

Keywords: Entomopathogenic fungi, *Macrotermes*, Termites, *Termitomyces*, *Trichoderma viride*