

Antimicrobial and antifungal activity of *Aegle marmelos* L. water extract for managing *Solanum lycopersicum* L. plant diseases

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The present study targets the management of tomato plant diseases caused by bacterial and fungal pathogens through natural pesticides. The antimicrobial and antifungal activities of water extract from *Aegle marmelos* L. were assessed *in vitro* at various concentrations. For antimicrobial activity, the zone of inhibition (ZOI) was measured, revealing that at 100 mg/ml concentration, the plant extract exhibited a ZOI greater than 15 mm for bacterial strains, *Xanthomonas* spp. and *Clavibacter michiganensis* ssp. *michiganensis*. For antifungal activity, the percentage of inhibition was measured at different concentrations of the plant extract. At the highest concentration of 10 mg/ml, complete inhibition (100%) was observed for *Botrytis cinerea*, whereas 77.5% inhibition was observed for *Phytophthora nicotianae* var. *parasitica*. Subsequently, *in vivo* experiments were conducted where the plant extract was used as a natural pesticide. Compared to the control, the treated plots demonstrated a significantly higher survival rate. These findings suggest that *A. marmelos* L. water extract can serve as an effective natural pesticide, providing a viable alternative to chemical pesticides in tomato disease management.

Keywords: *Aegle marmelos* L., antifungal activity, antimicrobial activity, control experiment, plant pathogen.

nas spp.), while fungal pathogens such as gray mold (*Botrytis cinerea*) and buckeye rot (*Phytophthora nicotianae* var. *parasitica*) further threaten tomato crops. These diseases can lead to significant losses in yield and quality, adversely affecting the agricultural economy and food supply. Traditional treatments for these diseases often involve chemical pesticides, which, while effective, pose significant adverse effects. These include environmental pollution, development of pathogen resistance, and potential health risks to humans and non-target organisms²⁻⁶.

In light of these concerns, there is a growing need for sustainable and eco-friendly alternatives. One promising solution lies in the formulation of natural pesticides derived from plant extracts. Utilising natural sources not only mitigates the adverse effects associated with synthetic chemicals but also promotes a more sustainable approach to disease management in agriculture⁷. The present study focuses on the potential of *Aegle marmelos* L. Water extract as a natural pesticide, evaluating its antimicrobial and antifungal efficacy against key tomato pathogens both *in vitro* and *in vivo*. The findings aim to contribute to the development of safe, effective, and environmentally benign strategies for protecting tomato crops and enhancing agricultural productivity.