Design, Development, and Experimental Evaluation of a Nano-Enhanced Botanical Oil Formulation as a Sustainable and Environmentally Friendly Alternative to Conventional Chemical Pesticides for the Effective Control of Whitefly : A Dose–Response and Time-Dependent Study

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The increasing dependence on conventional chemical pesticides for agricultural pest control has raised serious environmental and health concerns, in addition to the growing resistance developed by insect pests. This study presents an innovative and sustainable approach for managing whitefly through the development of a nano-formulated sesame oil preparation. The aim of this project was to enhance the insecticidal efficiency, stability, and bioavailability of natural plant oil using nanotechnology, while reducing environmental impact. A nano-enhanced sesame oil formulation was designed and experimentally evaluated under controlled conditions. Different concentrations were tested alongside a control group to assess efficacy. The effectiveness of the treatment was analyzed through dose–response evaluation, time-dependent mortality assessment, and comparative analysis with conventional oil formulations. Results demonstrated a significant improvement in insecticidal activity in the nano-formulated oil compared to the traditional formulation, indicating enhanced stability and improved interaction with the target pest. The findings suggest that integrating nanotechnology with botanical oils can provide an eco-friendly, efficient, and potentially scalable alternative to synthetic pesticides. This approach supports sustainable agricultural practices and opens the door for future field applications and broader pest management strategies.

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