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Evaluating the Potential of X-Ray Radiation as a Control Method for Red Palm Weevil (Rhynchophorus ferrugineus) Larvae

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The Red Palm Weevil (Rhynchophorus ferrugineus) is a destructive pest threatening palm cultivation globally, causing severe economic and ecological impacts. Conventional control methods, including chemical pesticides, have proven inadequate, prompting exploration of alternative, environmentally sustainable strategies. This study investigates the potential of X-ray radiation as a control method targeting R. ferrugineus larvae, focusing on its efficacy, physiological effects, and integration into pest management programs.

Controlled laboratory experiments were conducted to expose larvae at various developmental instars to calibrated doses of X-ray and gamma radiation. The effects were evaluated through larval mortality, behavioral observations, developmental progress, and reproductive outcomes. The results demonstrated a strong dose-dependent response. High radiation doses achieved complete larval mortality, while sublethal doses significantly altered behavior, reduced feeding activity, and impaired movement. Notably, surviving larvae that reached adulthood exhibited reduced fecundity and fertility, indicating potential for sterilization and long-term population suppression.

Radiation sensitivity varied by developmental stage, with early instars displaying greater susceptibility to lower doses. Sublethal exposures also induced developmental delays and morphological abnormalities, limiting reproductive success. These findings highlight the potential use of X-ray radiation in Sterile Insect Technique (SIT) applications and its broader utility in integrated pest management (IPM) systems.

In contrast to chemical pesticides, radiation-based control offers targeted action with minimal environmental impact, aligning with sustainability goals. However, further studies are necessary to assess ecological implications, optimize dosage, and explore practical implementation, including scalable field application and portable irradiation systems.
Overall, the study supports the viability of X-ray radiation as an effective, eco-friendly method for controlling R. ferrugineus larvae and underscores the importance of continued research to advance its operational use in palm protection strategies.

Technical Track

Nuclear Applications and Radiation Processing

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