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Histopathological effect on larval growth and mortality of *Spodoptera litura* (Fabricius)

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Abstract

The rapid development of insecticide resistance in *Spodoptera litura* (Fabricius), a destructive polyphagous pest infesting over 70 crop species, necessitates sustainable alternatives to synthetic pesticides. The present study evaluated the bioinsecticidal efficacy and histopathological effects of *Pongamia pinnata* methanolic leaf extract against third-instar larvae under controlled laboratory conditions. Leaf disc bioassays were conducted using concentrations of 1 %, 0.50 %, 0.25 %, and 0.125 % on *Ricinus communis*, with 30 larvae per treatment. Mortality, growth inhibition, behavioural responses, and biochemical alterations were assessed. A clear concentration-dependent toxicity was observed, with maximum mortality ranging from 70 % to 93.33 %, reaching 100 % at 1 % concentration within 72 hours. Corrected mortality values were 92 %, 80 %, 60 %, and 40 % across descending concentrations. Probit analysis demonstrated a significant dose-response relationship ($Y = 6.396 + 1.848X$; slope = 1.848 ± 0.0389 SE), yielding LC_{50} and LC_{90} values of 0.176 % and 0.865 %, respectively. Treated larvae exhibited marked physiological and behavioural abnormalities, including reduced feeding, gut purging, haemolymph leakage, retracted thoracic legs, growth retardation, weight reduction, and malformed pupae. SDS-PAGE analysis revealed significant protein modulation, with reduction of mid-range proteins (30–70 kDa) and appearance of low molecular weight fragments (10–20 kDa), indicating metabolic disruption ($p < 0.05$). Histopathological examination of midgut tissues showed severe degeneration of columnar epithelial cells, cytoplasmic vacuolisation, disruption of the peritrophic membrane, and loss of cellular integrity, impairing digestive and absorptive functions. These findings confirm that bioactive phytochemicals in *P. pinnata*, such as karanjin and pongamol, induce toxicity through physiological, biochemical, and tissue-level damage. Overall, the study establishes *P. pinnata* as a potent eco-friendly botanical insecticide with significant potential for incorporation into integrated pest management strategies for sustainable control of *S. litura*.

Keywords: Botanical insecticide, larval mortality, midgut histopathology, *Pongamia pinnata*, probit analysis, *spodoptera litura*, sustainable pest management