Bioinsecticidal and Histopathological Effects of *Pongamia pinnata (L)* Leaf Extract Against *Spodoptera litura (F)*

Larvicidal, growth-regulatory, biochemical and midgut-level evidence for a botanical insecticide

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1 INTRODUCTION

- ***Spodoptera litura (Fabricius)*** **is an economically important polyphagous pest affecting a wide range of crops.**
- **Reliance on synthetic insecticides raises concern over resistance, chemical residues and environmental impact.**
- **Botanical insecticides offer a promising, potentially more sustainable eco-friendly approach to pest management.**
- ***Pongamia pinnata (L.)*** **Pierre is a bioactive plant whose secondary metabolites show recognized insecticidal potential.**
- **Its bioinsecticidal efficacy and associated histopathological effects against *S. litura* need further investigation.**

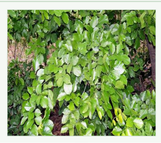
2 OBJECTIVES

To evaluate the bioinsecticidal efficacy of *Pongamia pinnata* leaf extract against *Spodoptera litura*, and to characterize its effects on larval feeding, development, mortality and midgut histopathology.

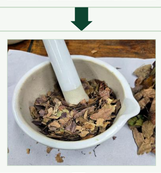
3 MATERIALS AND METHODS

Leaf Extract Preparation

i **Leaves collected**
Pongamia pinnata (L)
Voucher specimen DACN-1181; Nagpur, Maharashtra.



ii **Dried and powdered**
Shade-dried, then ground to fine powder.



iii **Soxhlet extraction**
90 % Methanol, 6–8 h extraction → filtration.

iv **Concentrated extract**
4 concentrations prepared (1%, 0.5%, 0.25%, 0.125%); stored at 4 °C.

Extract applied to bioassay

4 BIOASSAY & ANALYSIS

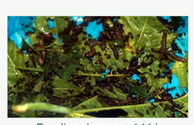
i **Leaf-disc bioassay setup**
Bioassay on 3-cm *Ricinus communis* leaf discs; concentrations 0.125, 0.25, 0.50 and 1.0%, plus distilled water as control.

ii **Larval exposure**
3 Replicates of 30 third-instar larvae per treatment exposed to treated leaf discs; mortality scored at 24–144 h.

iii **Feeding & mortality scoring**
Feeding damage recorded at each interval; mortality corrected against control (Abbott's formula).

Feeding damage, 24 h

iv **Data analysis & tissue profiling**
Probit analysis → LC_{50} and LC_{90}. Midgut histology (Alcian blue–nuclear fast red, 40×) and haemolymph SDS–PAGE on survivors.



Feeding damage, 144 h

5 LARVAL MORTALITY OVER TIME

0.176% LC_{50} (96 h) | **0.865%** LC_{90} (96 h) | **100%** Mortality at 1% within 48 h

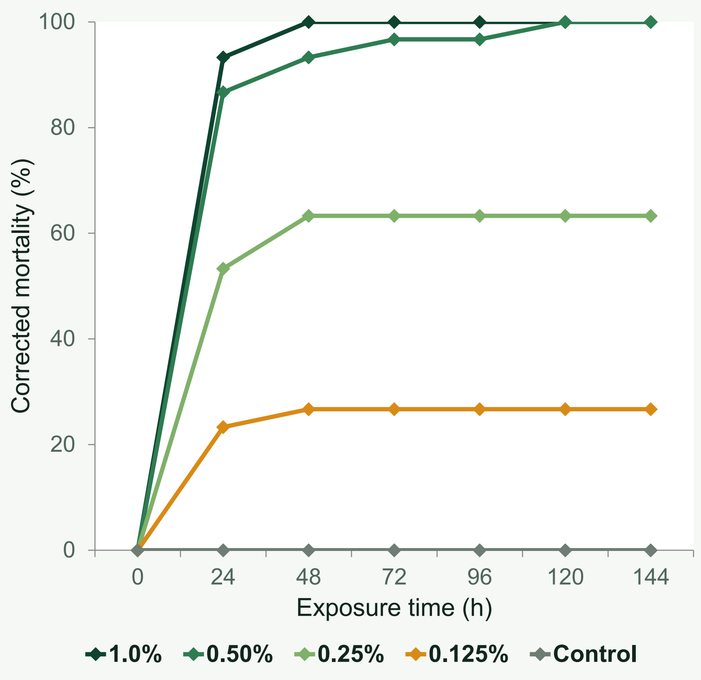
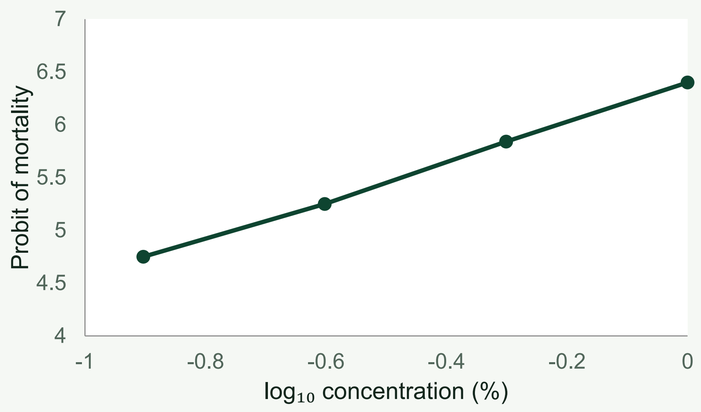


Fig. 1 · Corrected mortality rose steeply within 24 h and plateaued by 48 h; no control mortality throughout.

6 DOSE–RESPONSE (PROBIT)



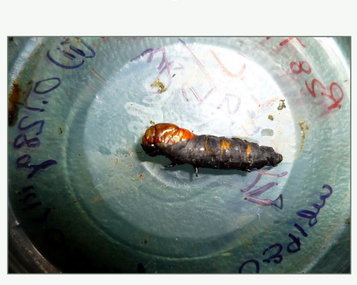
Probit Y = 6.396 + 1.848 X
slope 1.848 ± 0.039 SE LC_{50} 0.176% LC_{90} 0.865%

Fig. 2 · Probit-transformed mortality against log_{10} concentration.

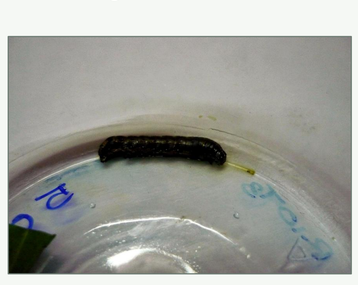
7 LARVAL FEEDING & DEVELOPMENT

Reduced feeding

Retarded growth



Haemolymph leakage



Body darkening, low mobility

- **Antifeedant action preceded mortality at every dose.**
- **Moulting failure and developmental abnormalities in survivors.**

8 MIDGUT HISTOPATHOLOGY

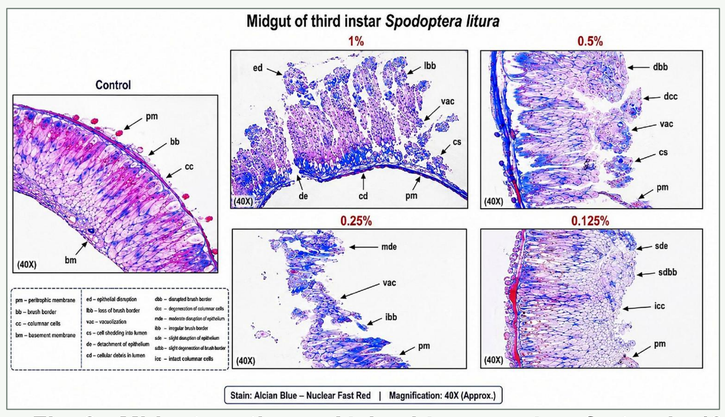


Fig. 3 · Midgut sections · Alcian blue – nuclear fast red · 40×

- **Control: intact columnar cells, brush border and peritrophic membrane.**
- **Treated: epithelial detachment, cytoplasmic vacuolization, cells shed into the lumen.**
- **Damage scaled with dose — 1% caused severe disorganization and loss of the peritrophic membrane.**

9 SDS–PAGE PROTEIN PROFILE

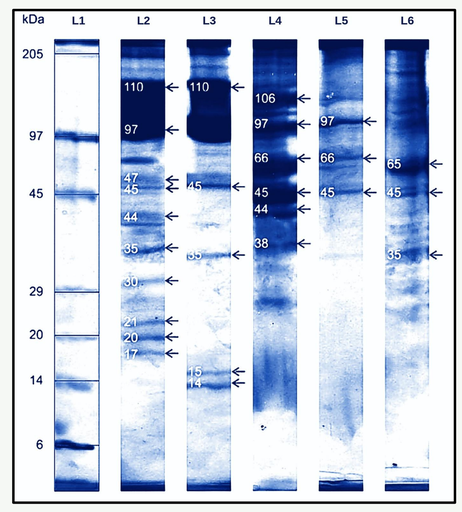


Fig. 4 · Coomassie Brilliant Blue R-250. L1 – Ladder · L2 – Control · L3 – 0.125% · L4 – 0.25% · L5 – 0.50% · L6 – 1.0%.

- **Concentration-dependent loss and thinning of high-mass bands (110, 97 kDa).**
- **New and intensified low-mass bands appear at higher doses.**
- **Altered protein profile signals metabolic and detoxification stress.**

10 CONCLUSIONS

- ***Pongamia pinnata*** **leaf extract exerted clear concentration-dependent antifeedant and larvicidal activity against *Spodoptera litura*** **(LC_{50} 0.176%, LC_{90} 0.865%).**
- **At the highest concentration (1%), larval mortality reached 100% within 48 h, alongside marked feeding inhibition and developmental abnormalities in survivors.**
- **Midgut histopathology confirmed severe epithelial and peritrophic membrane disruption, corroborated by shifts in haemolymph protein profiles.**
- **Together, these findings identify *Pongamia pinnata* leaf extract as a credible candidate for sustainable, botanically based management of *S. litura*.**

11 FUTURE DIRECTIONS

i **Field validation**
Stable formulation development in field trials.

ii **Standardize actives**
Karanjin and pongamol content across batches.

iii **Non-target screening**
Effects on natural enemies and pollinators.

TAKE-WAY MESSAGE

Pongamia pinnata (L) **leaf extract attacks on three fronts at once — it stops feeding, dismantles the midgut and rewrites the haemolymph protein profile — a credible botanical tool for resilient pest management for sustainable agro-ecosystems.**

REFERENCES

Datta R. et al. (2019) Effect of Alpinia galanga extracts on nutritional physiology of Spodoptera litura. Ecotoxicol Environ Saf 168:324–329.
Dinesh-Kumar A. et al. (2018) Target and non-target response of Swietenia mahagoni constituents against S. litura. Chemosphere 199:35–43.
Kedia A. et al. (2015) Botanicals as eco-friendly biorational alternatives to synthetic pesticides. J Food Sci Technol 52:1239–1257.
Aktar M.W. et al. (2009) Impact of pesticide use in agriculture: benefits and hazards. Interdiscip Toxicol 2:1–12.

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