

Batocera rufomaculata: A Review

बैटोसेरा रूफोमैकुलेटा: एक समीक्षा

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सारांश

बैटोसेरा रूफोमैकुलेटा, जिसे आमतौर पर आम के तनों को छेदने वाले कीट या अंजीर के वृक्ष को नुकसान पहुंचाने वाले कीट के रूप में जाना जाता है, लॉंगहॉर्न बीटल (Cerambycidae) परिवार की एक प्रमुख प्रजाति है, जो उष्णकटिबंधीय और उपोष्णकटिबंधीय क्षेत्रों में व्यापक रूप से पाई जाती है। यह कीट विभिन्न आर्थिक दृष्टि से महत्वपूर्ण फलदार और सजावटी पेड़ों के लिए गंभीर खतरा उत्पन्न करता है। यह समीक्षा *B. rufomaculata* से संबंधित वर्गिकी, जीवविज्ञान, वितरण, पोषक वृक्षों की विविधता, जीवन चक्र, आर्थिक महत्व, पारिस्थितिक अंतःक्रियाएं और प्रबंधन रणनीतियों पर केंद्रित है। विशेष रूप से, इसमें जैविक और एकीकृत कीट प्रबंधन (IPM) की दिशा में हालिया प्रगति को रेखांकित किया गया है। इस कीट के जीवन चक्र और नियंत्रण विधियों की समझ सतत कृषि और वानिकी के लिए अत्यंत आवश्यक है।

कुंजी : बैटोसेरा रूफोमैकुलेटा, बीटल, कीट, तने, शाखाएं

Abstract

Batocera rufomaculata, commonly known as the mango stem borer or the fig tree borer, is a longhorn beetle species (family Cerambycidae) widely distributed across tropical and subtropical regions. It poses a serious threat to a variety of economically significant fruit and ornamental trees. This review comprehensively outlines the taxonomy, biology, distribution, host range, life cycle, economic importance, ecological interactions, and management strategies associated with *B. rufomaculata*. Special emphasis is placed on recent advances in pest control, including biological and integrated pest management techniques. Understanding the pest's biology and control mechanisms is vital for sustainable agriculture and forestry.

Keywords: *Batocera rufomaculata*, beetle, pest, trunks, branches

1. Introduction

Batocera rufomaculata (De Geer, 1775), a notorious pest of fruit trees, is one of the most widespread and damaging cerambycid beetles in tropical regions. Native to Asia, it has been introduced to several parts of the world via international trade in wood and plant materials. Its larval stage causes significant damage by boring into tree trunks and branches, leading to reduced fruit yield, structural weakness, and eventual death of the host plant.

2. Taxonomy and Systematics

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Coleoptera

Family: Cerambycidae

Genus: *Batocera*

Species: *Batocera rufomaculata* (De Geer, 1775)

This beetle belongs to the subfamily Lamiinae and is closely related to other stem-boring beetles within the genus *Batocera*. It is often confused with *Batocera rubus* and *Batocera horsfieldi*, but distinguishable through morphological traits such as elytral coloration and size.

3. Morphology

Adult *B. rufomaculata* are large beetles, 25–55 mm in length, with a greyish-brown body mottled with reddish or orange spots. The antennae are long, especially in males, often exceeding twice the body length. The elytra bear characteristic reddish-brown maculae from which the species derives its name ("*rufomaculata*" means "red-spotted").

The larva is creamy white, soft-bodied, and legless, growing up to 80 mm in length. It has powerful mandibles used for boring into woody tissue. Pupation occurs within the host tree.

4. Geographic Distribution

B. rufomaculata has a pan-tropical distribution. It is found in:

Asia: India, Sri Lanka, China, Pakistan, Nepal, Thailand, Malaysia, Indonesia, and the Philippines

Africa: Egypt, Kenya, South Africa, and other Sub-Saharan countries

Europe: Introduced in parts of southern Europe

Americas: Introduced in some Caribbean islands and South America

Oceania: Australia, Papua New Guinea

The beetle thrives in tropical and subtropical climates and is considered an invasive species in many regions outside its native range.

5. Host Plants

Batocera rufomaculata is highly polyphagous. Its larvae infest over 100 plant species, primarily woody perennials. Notable hosts include:

Fruit trees: Mango (*Mangifera indica*), fig (*Ficus carica*), guava (*Psidium guajava*), jackfruit (*Artocarpus heterophyllus*), papaya (*Carica papaya*), pomegranate (*Punica granatum*)

Ornamentals and shade trees: Banyan (*Ficus benghalensis*), rubber (*Hevea brasiliensis*), flame of the forest (*Butea monosperma*)

- **Timber trees:** Casuarina, Albizia, and Eucalyptus spp.

Among these, mango trees are the most severely affected, earning the pest its common name.

6. Life Cycle and Development

The life cycle of *B. rufomaculata* is typically univoltine, although multivoltinism occurs in warmer climates.

Egg stage: Females lay eggs singly in bark crevices or wounds using an ovipositor. Each female can lay 50–200 eggs during her lifetime.

Larval stage: After hatching, larvae bore into the cambium and then the heartwood. This stage lasts 3–6 months.

Pupal stage: Pupation occurs inside the tree in a pupal chamber made by the larva. The pupal period lasts 3–4 weeks.

Adult emergence: Adults emerge through round exit holes, typically during summer or post-monsoon months, depending on climate.

Environmental conditions such as temperature, humidity, and host quality influence development time.

7. Economic Importance

The economic impact of *B. rufomaculata* is significant in horticulture and forestry:

Crop loss: Infestation leads to reduced fruit production, often by 30–70% in mango orchards.

Tree mortality: Heavy larval feeding weakens trees, making them prone to wind breakage or secondary infections.

Trade restrictions: Presence of this pest limits export potential of fruits and timber.

Management costs: Preventive and curative measures require extensive labor and cost, especially in large orchards.

8. Ecological Interactions

Predators: Birds, parasitic wasps (e.g., *Scleroderma* spp.), and entomopathogenic fungi naturally regulate populations.

Symbiosis: Larvae are associated with gut microbiota that aid in lignocellulose digestion.

Competition: Larvae often compete with other wood-boring insects like *Xyleborus* spp.

Pathogens: Susceptible to *Beauveria bassiana* and *Metarhizium anisopliae* under lab and field conditions.

These interactions offer opportunities for biocontrol approaches.

9. Detection and Monitoring

Visual inspection: Presence of frass, sap oozing, and exit holes are key indicators.

Acoustic detection: Larval feeding sounds are detectable using specialized microphones.

Traps: Pheromone and light traps are under development but are not widely adopted.

Remote sensing: Emerging tools like drones and spectral imaging may enhance early detection.

10. Management Strategies

10.1 Cultural Control

Removal and destruction of infested trees.
 Regular pruning of dead branches.
 Avoidance of mechanical injuries to bark during cultivation.

10.2 Mechanical Control

Use of wire probes or metal rods to kill larvae inside tunnels.
 Banding trees to prevent egg-laying.

10.3 Chemical Control

Systemic insecticides such as imidacloprid or monocrotophos applied through trunk injection or soil drench.
 Contact insecticides used as bark sprays.
 However, chemical control raises concerns of residue, resistance, and non-target effects.

10.4 Biological Control

Use of parasitoids like *Scleroderma guani*.
 Entomopathogenic fungi and nematodes.
 Exploration of egg parasitoids and fungal symbionts.
 Biological methods are eco-friendly and sustainable but require further field validation.

10.5 Integrated Pest Management (IPM)

Combines all available tools: cultural, biological, and chemical.
 Emphasizes regular monitoring, threshold-based interventions, and farmer education.
 Case studies in India and Southeast Asia show reduced infestation and improved tree health with IPM.

11. Recent Advances in Research

Molecular identification: Molecular tools, especially mitochondrial cytochrome c oxidase subunit I (COI) gene sequencing, have become critical in resolving species boundaries and confirming morphological identifications of cryptic and polymorphic taxa. DNA barcoding using the COI gene provides a reliable, standardized method for identifying *Batocera rufomaculata*, particularly in its larval stage, which lacks distinct morphological characters. A significant contribution in this domain is the morphomolecular study on the flat-

faced longhorn beetle *Batocera rufomaculata* (De Geer, 1775) from Rehla, Palamu, Jharkhand, India, which utilized both morphological traits and COI-based DNA barcoding to validate species identity. This integrative approach confirmed the taxonomic placement of the species and provided a genetic reference point for populations in eastern India. Such studies are essential for regional pest surveillance, phylogeographic studies, and quarantine assessments.

The barcoding approach not only aids in accurate identification but also uncovers intraspecific variation and cryptic diversity within *B. rufomaculata*, thereby supporting efforts to map its biogeographic spread and develop targeted pest control strategies.

Microbial symbionts: Studies on larval gut microbiota reveal potential for biofuel research and pest suppression.

Genetic markers: SSR and RAPD markers have been used to assess genetic diversity among populations.

Pheromone development: Isolation and synthesis of male-produced aggregation pheromones are underway.

Remote sensing and AI: Machine learning models are being trained to detect infestation signs via satellite imagery and acoustic sensors.

12. Challenges and Future Directions

Lack of awareness: Many farmers misdiagnose infestation symptoms.

Climate change: Expanding range and voltinism due to rising temperatures.

Limited biological control: Inadequate field-level validation of biocontrol agents.

Regulatory gaps: Poor quarantine measures allow pest spread across borders.

Future efforts must focus on:

Development of effective attractants and pheromone traps.

Use of resistant plant varieties through breeding and biotechnology.

Enhanced quarantine and surveillance protocols.

Farmer training and outreach through digital platforms.

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