COFFEE PEST & DISEASE

DETECTION & MANAGEMENT REFERENCE

For Use with AI-Powered Scanning Application

Covers: Coffee Leaf Miner • Coffee Leaf Rust • Cercospora Leaf Spot • Phoma Twig Blight • Coffee Berry Borer

Prepared for: Agricultural Extension & Precision Farming Programs

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How to Read This Reference Document

This reference document is structured to mirror exactly what the AI scanning application displays after detecting a coffee pest or disease. Each of the five pests/diseases covered follows a consistent layout:

1. Name of Disease / Pest – includes scientific name, detection confidence, and severity rating
2. Symptoms – visual and physiological signs to look for
3. Causes & Risk Factors – pathogen or pest biology and environmental triggers
4. Impact – agronomic and economic consequences
5. Seven-Day Action Plan – tailored daily schedule based on severity
6. Immediate Response – urgent first steps within 24 hours of detection
7. Long-Term Strategy – prevention and sustainable management

Severity levels throughout this document are defined as: Mild, Moderate, and Severe—corresponding to the percentage of plant tissue or berries affected as detected by the scanning application.

PEST / DISEASE 1 OF 5

1. Coffee Leaf Miner

Scientific Name: *Leucoptera coffeella*

Description

The Coffee Leaf Miner (Leucoptera coffeella) is one of the most damaging insect pests of coffee in Latin America, Africa, and parts of Asia. It is a small white moth whose larvae tunnel (mine) inside coffee leaves, creating characteristic blotch or serpentine galleries visible on the leaf surface. Infestations reduce the plant's photosynthetic capacity, weaken overall tree health, and — when severe — cause significant premature leaf drop and yield loss. The pest thrives in warm, dry conditions and in farms with little canopy shade or natural enemy populations. Early detection through regular scouting is essential, as populations can multiply rapidly during dry seasons.

Detection Confidence	High (85–95%)
Severity Levels	Mild (1–10% leaf area affected) | Moderate (10–30%) | Severe (>30%)

2. Symptoms

- Irregular serpentine or blotch-shaped mines on leaf surface
- Yellowing and browning of affected leaf areas
- Premature leaf drop in severe infestations
- Visible larvae or pupae inside leaf tissue when mines are opened
- Reduced photosynthetic capacity leading to stunted plant growth

3. Causes & Risk Factors

- Infestation by the moth Leucoptera coffeella (coffee leaf miner)
- Adult moths lay eggs on leaf surfaces; larvae tunnel into leaf tissue
- High temperatures (25–30°C) and low humidity favor population explosions
- Monoculture farming and lack of natural predators increase risk
- Poor farm sanitation and dense canopy create ideal breeding conditions

4. Impact

- Reduction in photosynthesis leading to yield losses of 10–40%
- Weakened plant immunity making trees susceptible to secondary infections
- Increased production costs due to chemical treatments
- Long-term soil and biodiversity degradation if pesticides are overused

5. Seven-Day Action Plan (Based on Severity)

The schedule below applies across all severity levels. For Mild severity, Day 3 biological treatment may suffice and chemical treatment on Day 4 may be skipped. For Severe cases, all steps are critical.

Day 1 – Scouting & Assessment: Walk all rows, record infested leaf percentage per tree. Map hotspots on a farm sketch. Note canopy density and microclimate.

Day 2 – Pruning & Sanitation: Remove and bag severely mined leaves. Prune dense inner branches to improve airflow and reduce micro-humidity. Do NOT compost infested material.

Day 3 – Biological Treatment: Apply Bacillus thuringiensis (Bt) foliar spray on mild–moderate areas. Release Chrysoperla carnea (lacewing) predators if available.

Day 4 – Chemical Treatment (if Severe): Apply systemic insecticide (e.g., imidacloprid 200 SL at label rate) to severely infested blocks. Avoid spraying during flowering to protect pollinators.

Day 5 – Re-scouting & Trap Setup: Install pheromone traps (1 per hectare) to monitor adult moth populations. Record trap catches to track infestation trend.

Day 6 – Monitoring & Data Recording: Check pheromone traps, record counts. Inspect treated trees for larval mortality. Photograph mine progression for comparison.

Day 7 – Nutrition & Recovery: Apply foliar fertilizer (NPK 20-20-20 + micronutrients) to support leaf recovery. Add organic mulch at tree base to improve soil moisture.

6. Immediate Response

Take these actions within 24 hours of detection:

- Isolate severely affected trees with physical markers
- Apply neem oil spray (5 mL/L) as an organic first-response measure
- Remove and destroy all mined leaves in sealed plastic bags
- Notify neighboring farms if infestation is widespread

7. Long-Term Strategy

- Introduce and maintain shade trees to create unfavorable conditions for adult moths
- Implement integrated pest management (IPM) combining biological, cultural, and chemical controls
- Establish habitat for natural enemies (lacewings, parasitic wasps)
- Rotate chemical classes annually to prevent resistance build-up
- Conduct bi-weekly scouting throughout the growing season
- Maintain farm records for trend analysis and early intervention

References & Sources

8. *Souza, J.C. & Reis, P.R. (1997). Coffee Leaf Miner: Biology, Damage and Management. EPAMIG Technical Bulletin.*
9. *Teodoro, A.V. et al. (2009). Management of Leucoptera coffeella in Coffee. Pest Management Science, 65(4), 418–425.*
10. *CABI. (2023). Leucoptera coffeella (Coffee Leaf Miner). Invasive Species Compendium. www.cabi.org*

2. Coffee Leaf Rust

Scientific Name: *Hemileia vastatrix*

Description

Coffee Leaf Rust, caused by the fungal pathogen Hemileia vastatrix, is the single most economically destructive disease of coffee worldwide. First documented in Sri Lanka in 1869, it has since spread to all major coffee-growing regions, triggering devastating epidemics including the catastrophic 2012–2013 outbreak in Central America that destroyed over 70% of some nations' crops. The disease attacks Arabica varieties (Coffea arabica) with particular severity, producing characteristic orange-yellow powdery pustules on the underside of leaves. Infected leaves lose their ability to photosynthesize and drop prematurely, stripping trees of their productive canopy. Without intervention, a single rainy season can escalate a mild infection into a farm-wide epidemic.

Detection Confidence	Very High (90–98%)
Severity Levels	Mild (scattered orange pustules, <10% canopy) | Moderate (10–40% defoliation) | Severe (>40% defoliation, branch die-back)

2. Symptoms

- Pale yellow-orange powdery pustules on the undersides of leaves
- Corresponding chlorotic (yellow) spots on the upper leaf surface
- Progressive browning and necrosis of affected leaf areas
- Premature and extensive leaf drop (defoliation)
- Reduced berry set and significant yield loss in severe cases
- Complete branch dieback in unmanaged outbreaks

3. Causes & Risk Factors

- Fungal infection by Hemileia vastatrix (obligate biotrophic basidiomycete)
- Spores (urediniospores) dispersed by wind, rain splash, insects, and farm tools
- Optimal infection: temperatures 15–28°C with high relative humidity (>80%)
- Rainy seasons and poor drainage accelerate epidemic spread
- Susceptible Arabica varieties (e.g., Typica, Bourbon) at highest risk
- Nitrogen over-fertilization promotes lush growth vulnerable to infection

4. Impact

- Yield losses of 30–80% in severe, unmanaged epidemics
- Weakened trees with reduced lifespan and productivity
- Increased economic burden—one of the most costly coffee diseases globally
- Forced early harvesting of under-ripe cherries in heavily affected farms
- Loss of farmer livelihoods especially in smallholder settings

5. Seven-Day Action Plan (Based on Severity)

The schedule below applies across all severity levels. For Mild severity, Day 3 biological treatment may suffice and chemical treatment on Day 4 may be skipped. For Severe cases, all steps are critical.

Day 1 – Scouting & Severity Mapping: Survey entire farm, grade each tree as mild/moderate/severe. Mark GPS coordinates of hotspots. Count percentage of affected leaves per branch.

Day 2 – Pruning & Defoliation Management: Remove and bag all heavily infected leaves. Prune crossing branches to improve canopy airflow. Avoid leaving pruned material on the ground.

Day 3 – Copper-Based Fungicide Treatment: Apply copper hydroxide ($Cu(OH)_2$) or copper oxychloride at 2.5–3 g/L to mild and moderate trees. Ensure thorough coverage of leaf undersides.

Day 4 – Systemic Fungicide (Moderate–Severe): Apply triazole fungicide (e.g., tebuconazole or triadimefon) to moderate-severe trees. Follow label intervals—do not tank-mix copper and triazoles on same day.

Day 5 – Re-scouting & Spore Trap Setup: Assess treated trees for new pustule development. Set up spore sampling traps to measure airborne inoculum. Record weather data (temp/humidity).

Day 6 – Monitoring & Canopy Assessment: Photograph and compare pustule activity against Day 1 baseline. Document defoliation percentage. Alert agronomist if new areas show infection.

Day 7 – Nutrition & Plant Recovery: Apply potassium-rich fertilizer (0-0-60 SOP at recommended rate) to strengthen cell walls. Add silicon (Si) foliar spray as additional resistance booster.

6. Immediate Response

Take these actions within 24 hours of detection:

- Apply copper-based fungicide (Bordeaux mixture or copper hydroxide) immediately
- Remove all visibly infected leaves and dispose of them off-site
- Increase canopy airflow through targeted pruning
- Temporarily reduce nitrogen fertilization to slow lush, susceptible growth
- Alert neighboring coffee farmers to coordinate area-wide response

7. Long-Term Strategy

- Transition to rust-resistant varieties (e.g., Catimor, Sarchimor, or local resistant hybrids)
- Establish a preventive fungicide calendar: copper sprays every 3–4 weeks during rainy season
- Maintain balanced nutrition—excess nitrogen increases rust susceptibility
- Introduce shade management to reduce humidity while preserving microclimates
- Train farm workers in early detection and reporting protocols
- Participate in regional rust monitoring networks and early warning systems

References & Sources

11. *Kushalappa, A.C. & Eskes, A.B. (1989). Advances in Coffee Rust Research. Annual Review of Phytopathology, 27, 503–531.*
12. *Avelino, J. et al. (2015). The Coffee Rust Crises in Colombia and Central America. Food Security, 7(2), 303–321.*
13. *FAO. (2020). Coffee Leaf Rust Management Guidelines. Food and Agriculture Organization of the United Nations.*
14. *Talhinhas, P. et al. (2017). The Coffee Leaf Rust Pathogen Hemileia vastatrix. Molecular Plant Pathology, 18(8), 1039–1051.*

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3. Cercospora Leaf Spot

Scientific Name: *Cercospora coffeicola*

Description

Cercospora Leaf Spot, caused by the fungus Cercospora coffeicola, is a widespread fungal disease affecting coffee in all major producing countries. It is particularly damaging in nurseries and young plantings, where it can cause devastating seedling losses. The disease is easily identified by its characteristic circular brown spots with a pale gray or whitish center — a pattern sometimes called 'brown eye spot.' In addition to foliage damage, the pathogen infects developing coffee cherries, causing surface blemishes that reduce the marketable quality and cup profile of the harvested coffee. Cercospora thrives in conditions of high humidity, poor nutrition, and inadequate canopy airflow, making it especially problematic in poorly managed or overly shaded plantations.

Detection Confidence	High (80–93%)
Severity Levels	Mild (few isolated spots, <5% leaf area) | Moderate (coalescing spots, 5–25%) | Severe (lesions cover >25%, fruit infection visible)

2. Symptoms

- Circular to irregular brown spots with whitish-gray centers on leaves
- Yellow halo surrounding each lesion on the upper leaf surface
- Lesions may coalesce forming large necrotic patches in moderate-severe cases
- Dark brown to black 'eye-spot' pattern visible on mature lesions
- Fruit infection: reddish-brown spots on coffee cherries (brown eye on berries)
- Premature fruit drop and internal discoloration of infected cherries

3. Causes & Risk Factors

- Fungal pathogen Cercospora coffeicola (Ascomycete)
- Spores spread via wind and rain splash from infected leaf/fruit debris

- Thrives in conditions of high humidity, poor drainage, and dense planting
- Nutritionally stressed plants (low N, Zn, Mg) show higher disease incidence
- Overripe or damaged fruits are entry points for infection
- Seedlings and nurseries particularly vulnerable to severe outbreaks

4. Impact

- Yield loss of 10–35% due to premature fruit drop and fruit quality reduction
- Grade reduction of harvested coffee—spotted berries downgraded or rejected
- Nursery losses can reach 50–70% if outbreaks occur in seedling stage
- Weakened plant vigor reducing long-term productivity

5. Seven-Day Action Plan (Based on Severity)

The schedule below applies across all severity levels. For Mild severity, Day 3 biological treatment may suffice and chemical treatment on Day 4 may be skipped. For Severe cases, all steps are critical.

Day 1 – Field Assessment & Sampling: Collect 10 leaves and 5 fruits per tree from 20 random trees. Estimate % leaf area and % fruit affected. Record data by field block.

Day 2 – Sanitation & Pruning: Remove and destroy infected leaves and fallen fruits. Prune to reduce canopy density. Avoid overhead irrigation to reduce splash dispersal.

Day 3 – Copper Fungicide Application: Apply copper oxychloride (3 g/L) or mancozeb (2 g/L) as a protective spray. Target undersides of leaves where sporulation occurs.

Day 4 – Systemic Fungicide (Moderate-Severe): Apply thiophanate-methyl or azoxystrobin if disease pressure is moderate to severe. Alternate between chemical classes to manage resistance.

Day 5 – Soil & Nutrition Correction: Apply zinc sulfate (0.5%) foliar spray to address micronutrient deficiency. Topdress with balanced NPK fertilizer adjusted to soil test recommendations.

Day 6 – Monitoring & Environmental Assessment: Re-examine treated trees. Monitor weather—watch for rainfall events that re-trigger sporulation. Record new lesion development vs treated areas.

Day 7 – Plant Recovery Nutrition: Apply magnesium sulfate (Epsom salt, 2 g/L) foliar spray. Add boron (0.1%) to improve fruit development and reduce infection entry points.

6. Immediate Response

Take these actions within 24 hours of detection:

- Remove and dispose of heavily spotted leaves and infected berries immediately
- Apply mancozeb or copper-based fungicide as emergency protective spray
- Improve drainage around affected trees
- Correct nutritional deficiencies—especially zinc and nitrogen—with foliar treatment

7. Long-Term Strategy

- Maintain balanced crop nutrition program with annual soil and leaf tissue analysis
- Avoid over-shading which promotes high humidity and spore germination

- Schedule preventive fungicide applications before and during rainy seasons
- Use disease-free planting materials from certified nurseries
- Implement proper post-harvest sanitation—remove all mummified fruits
- Select planting densities that allow adequate airflow between trees

References & Sources

15. *Waller, J.M. et al. (2007). Coffee Pests, Diseases and Their Management. CABI Publishing, Wallingford, UK.*
16. *Erwin, D.C. & Ribeiro, O.K. (1996). Phytophthora Diseases Worldwide. APS Press.*
17. *Varzea, V.M.P. & Marques, D.V. (2005). Population Variability of Hemileia vastatrix vs Resistance in Coffee. In: Durable Resistance to Coffee Leaf Rust. CIRAD.*

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4. Phoma Twig Blight

Scientific Name: *Phoma costaricensis / Botrytis cinerea complex*

Description

Phoma Twig Blight is a fungal disease primarily caused by Phoma costaricensis, and is most prevalent in high-altitude coffee-growing regions (above 1,200 m above sea level) where cool temperatures and prolonged wet conditions create ideal conditions for the pathogen to thrive. The disease causes progressive die-back of young shoots and twigs, often starting at the tips and working downward — a symptom pattern that can be confused with frost damage or drought stress. In severe, unmanaged cases, the fungus can invade older stems and form deep trunk cankers that threaten the structural integrity and long-term productivity of the tree. High-altitude specialty coffee farms are particularly vulnerable, as the combination of cold stress and high humidity significantly lowers plant resistance.

Detection Confidence	Moderate–High (75–90%)
Severity Levels	Mild (tip die-back on isolated branches) | Moderate (multiple branches affected, 10–30% canopy) | Severe (trunk lesions, >30% canopy die-back, plant mortality risk)

2. Symptoms

- Water-soaked lesions on young shoots and twigs, rapidly darkening to brown-black
- Tip die-back progressing downward along branches (blighting pattern)
- Dark, sunken cankers on older stems and trunks in severe cases
- Circular brown lesions on leaves, often starting at leaf margins or tip
- Premature drop of affected leaves and young berries
- White to grey fluffy mycelium visible in humid conditions

- Pycnidia (small black fungal fruiting bodies) visible on dead tissue

3. Causes & Risk Factors

- Fungal pathogens in Phoma genus (primarily P. costaricensis in coffee)
- Thrives in cool, wet, high-altitude conditions (>1200 m asl)
- Conidia dispersed by rain splash and wind during wet periods
- Wounds from pruning, frost, or insects are primary entry points
- Over-dense canopy creating high-humidity microenvironments
- Cold-stressed plants at high elevations show increased susceptibility

4. Impact

- Significant structural damage—twig and branch loss reduces bearing surface
- Yield losses of 15–50% in high-altitude farms during rainy seasons
- Increased labor costs for remediation pruning and treatment
- Plant death in nurseries and young plantings if uncontrolled

5. Seven-Day Action Plan (Based on Severity)

The schedule below applies across all severity levels. For Mild severity, Day 3 biological treatment may suffice and chemical treatment on Day 4 may be skipped. For Severe cases, all steps are critical.

Day 1 – Disease Mapping & Assessment: Map affected trees by severity grade. Note altitude, aspect, and drainage conditions. Photograph canker progression on trunk and branches.

Day 2 – Pruning & Wound Management: Prune all blighted twigs 10 cm below visible lesion margin. Paint cut surfaces with Bordeaux paste or copper-based wound sealant immediately after pruning.

Day 3 – Fungicide Application – Mild/Moderate: Apply mancozeb + copper oxychloride mixture (2 + 2 g/L) to entire canopy. Ensure thorough coverage of twig junctions and stem bases.

Day 4 – Systemic Fungicide – Moderate/Severe: Apply trifloxystrobin or azoxystrobin (QoI group) at label rate. Alternate with carbendazim for severe trunk cankers. Do not exceed label applications.

Day 5 – Drainage & Canopy Improvement: Improve soil drainage by creating channels to divert waterlogging. Thin canopy further to reduce humidity. Document canopy density before and after.

Day 6 – Monitoring & Weather Logging: Check pruned and treated areas for new blight progression. Log temperature and humidity data. Reassess trunk lesion boundaries.

Day 7 – Recovery Nutrition: Apply calcium nitrate (10 g/L) foliar spray to strengthen cell walls. Add silicon-based amendment to soil to boost plant resistance.

6. Immediate Response

Take these actions within 24 hours of detection:

- Prune all visibly blighted twigs immediately—cutting below lesion margins

- Seal all pruning wounds with copper-based paste to prevent reinfection
- Apply systemic fungicide to severely affected trees
- Improve drainage around the base of affected trees

7. Long-Term Strategy

- Select planting sites with good drainage and air circulation
- Establish windbreaks at high-altitude farms to reduce cold stress
- Implement structured annual pruning calendar to maintain open canopy
- Monitor weather data to anticipate wet, cool periods requiring preventive sprays
- Use resistant or tolerant coffee varieties where available
- Avoid mechanical wounds during farm operations—use sharp, disinfected tools

References & Sources

18. *Rodrigues, C.J. et al. (1993). Phoma twig blight of coffee. CIRAD Plant Pathology Report.*
19. *Waller, J.M. et al. (2007). Coffee Pests, Diseases and Their Management. CABI Publishing.*
20. *ICO. (2019). Annual Review of Coffee Disease Threats. International Coffee Organization, London.*

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5. Coffee Berry Borer

Scientific Name: *Hypothenemus hampei*

Description

The Coffee Berry Borer (Hypothenemus hampei) is the most economically devastating insect pest of coffee globally, causing estimated annual losses of USD 500 million worldwide. This tiny dark-brown beetle (1.5–2 mm long) is unique in that the female bores directly into coffee cherries through the crown (distal end) and lays her eggs inside the endosperm — the coffee seed itself. The developing larvae feed on and destroy the seed from the inside, rendering the bean unmarketable. Infested beans are graded as defective and dramatically lower the cup quality score of harvested coffee. The Coffee Berry Borer is present in virtually all coffee-producing countries and is especially difficult to control because the insect spends most of its life cycle hidden inside the berry, protected from external treatments. Effective management relies heavily on cultural practices — particularly thorough and timely harvesting — combined with biological control agents.

Detection Confidence	Very High (88–97%)
Severity Levels	Mild (<5% berries infested) | Moderate (5–20% berries infested) | Severe (>20% berries infested)

2. Symptoms

- Tiny circular entry hole (0.5–1 mm) on the crown (distal end) of coffee cherries
- Fine powdery frass (sawdust-like material) around or within the entry hole
- Internal galleries visible when berry is split open—damage to endosperm (seed)
- Premature and irregular berry drop from infested fruits
- Presence of adult beetles (dark brown, 1.5–2 mm) on or in berries
- Weight loss in harvested coffee leading to hollow/light beans

3. Causes & Risk Factors

- Infestation by the beetle Hypothenemus hampei (Coleoptera: Curculionidae: Scolytinae)
- Female beetles bore into coffee berries to lay eggs inside the seed
- Highest risk during berry development—green stage most susceptible
- Temperatures of 20–30°C and humidity >80% accelerate population growth
- Delayed or incomplete harvest leaves residual berries as breeding sites
- Proximity to infested neighboring farms facilitates rapid spread

4. Impact

- Global economic loss estimated at USD 500 million annually
- Quality downgrade—bored beans rejected by specialty coffee buyers
- Yield losses of 20–80% in heavily infested unmanaged farms
- Increased post-harvest processing cost for sorting and grading
- Reduced cupping score—bored beans contribute to defective cup profiles

5. Seven-Day Action Plan (Based on Severity)

The schedule below applies across all severity levels. For Mild severity, Day 3 biological treatment may suffice and chemical treatment on Day 4 may be skipped. For Severe cases, all steps are critical.

Day 1 – Infestation Scouting & Counting: Sample 100 berries from 10 trees per hectare. Count and record % infested berries. Identify hotspot zones for targeted management.

Day 2 – Sanitation Harvesting: Strip-harvest all ripe and overripe berries from infested trees. Collect all fallen berries from the ground. Remove and destroy all residual berries after main harvest.

Day 3 – Biological Control Application: Apply Beauveria bassiana (entomopathogenic fungus) spray (1×10^8 conidia/mL) to entire berry surface. Best applied in the early morning or evening.

Day 4 – Chemical Treatment (Moderate–Severe): Apply endosulfan alternative (e.g., chlorpyrifos or spinosad at label rate) to moderate-severe hotspot blocks. Observe pre-harvest intervals strictly.

Day 5 – Trap Installation & BROCAP Setup: Install BROCAP or alcohol-based traps (1:1 methanol:ethanol) at 1 per 250 m^2. Record trap catches daily to monitor population density.

Day 6 – Monitoring & Post-Treatment Assessment: Re-sample 100 berries from treated areas. Compare infestation rate vs Day 1 baseline. Adjust trap placement based on capture data.

Day 7 – Nutrition & Canopy Recovery: Apply NPK foliar spray to support fruit fill and tree recovery. Add boron (0.1%) to improve fruit set quality and reduce stress susceptibility.

6. Immediate Response

Take these actions within 24 hours of detection:

- Immediately harvest all ripe and overripe berries—remove breeding substrate
- Collect all fallen berries from the ground and destroy them
- Apply Beauveria bassiana as first-response biological control
- Install alcohol-based attractant traps throughout the affected area
- Coordinate with neighboring farms for synchronized action

7. Long-Term Strategy

- Adopt selective strip-picking to minimize overripe berries remaining on tree
- Establish a 2-week harvest cycle during peak fruiting to reduce exposure time
- Maintain and expand Beauveria bassiana biological control program
- Implement 'Borer Management Traps' (BROCAP or Ethanol) year-round
- Train all farm workers in early detection—recognizing entry holes
- Ensure complete post-harvest sanitation: remove 100% of residual berries
- Collaborate with local coffee cooperatives on area-wide IPM programs

References & Sources

21. *Jaramillo, J. et al. (2010). Biological Control of Coffee Berry Borer. BioControl, 55(2), 261–268.*
22. *Damon, A. (2000). A Review of the Biology and Control of the Coffee Berry Borer, Hypothenemus hampei. Bulletin of Entomological Research, 90(6), 453–465.*
23. *Baker, P.S. (1999). The Coffee Berry Borer in Colombia. CABI Bioscience, Ascot, UK.*
24. *ICO. (2020). Coffee Berry Borer Management Guidelines. International Coffee Organization. www.ico.org*

General References & Further Reading

The following key texts and organizations provide comprehensive information on coffee pest and disease management:

25. *Waller, J.M., Bigger, M. & Hillocks, R.J. (2007). Coffee Pests, Diseases and Their Management. CABI Publishing, Wallingford, UK. ISBN: 978-1845931292*
26. *International Coffee Organization (ICO). Annual Reviews on Coffee Diseases and Pests. Available at: www.ico.org*
27. *CABI. (2023). Invasive Species Compendium – Coffee Pathogens and Pests. Available at: www.cabi.org/isc*
28. *Food and Agriculture Organization of the United Nations (FAO). (2020). Good Agricultural Practices for Coffee. FAO, Rome.*
29. *World Coffee Research (WCR). (2023). Agronomy & Pest Management Resources. Available at: www.worldcoffeeresearch.org*

30. *Avelino, J. et al. (2015). The Coffee Rust Crises in Colombia and Central America (2008–2013). Food Security, 7(2), 303–321. DOI: 10.1007/s12571-015-0446-9*
31. *Jaramillo, J. et al. (2010). Biological control of coffee berry borer: Beauveria bassiana—a comprehensive review. BioControl, 55(2), 261–268.*
32. *Philippine Coffee Board. (2022). Coffee Production and Disease Management Handbook. PhilCoffee Board, Quezon City.*