

Beyond Blame:

Past, Present and Future of Fusarium wilt management

Dr Tony Pattison

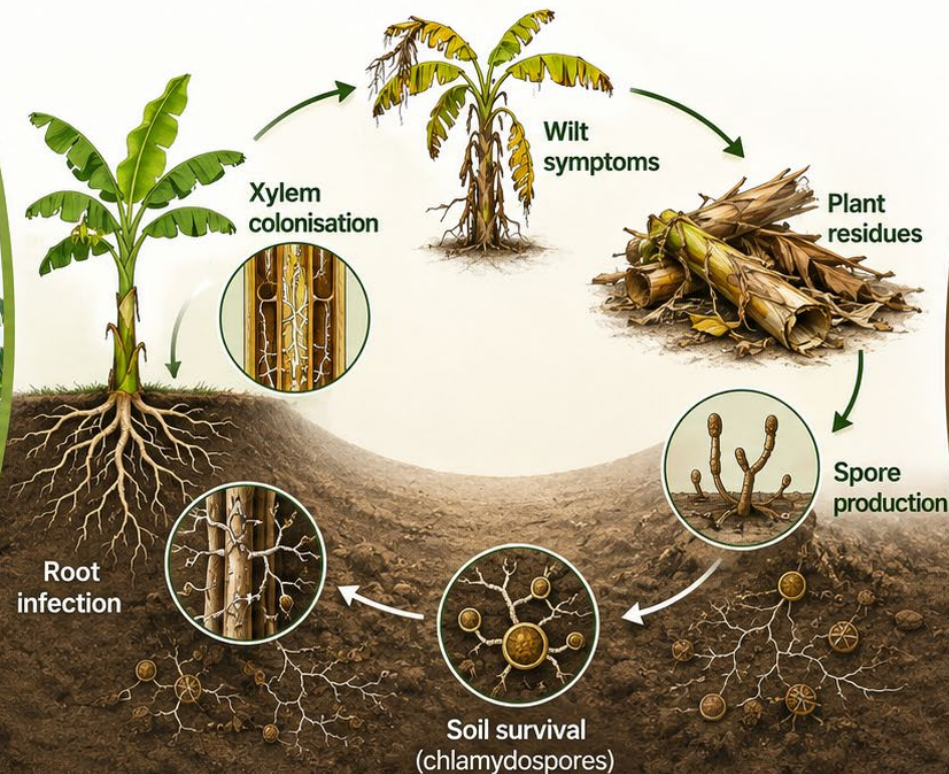
Queensland Department of Primary Industries



Biology determines the rules

TR4 survives in soil, infects roots, spreads through xylem, and rebuilds inoculum from diseased plants.

Healthy plantation



Devastated plantation



Once established, TR4 persists in soil and plant debris for years.
Prevention and containment are essential.



Fusarium Wilt Tropical Race 4 (TR4)

Global Distribution

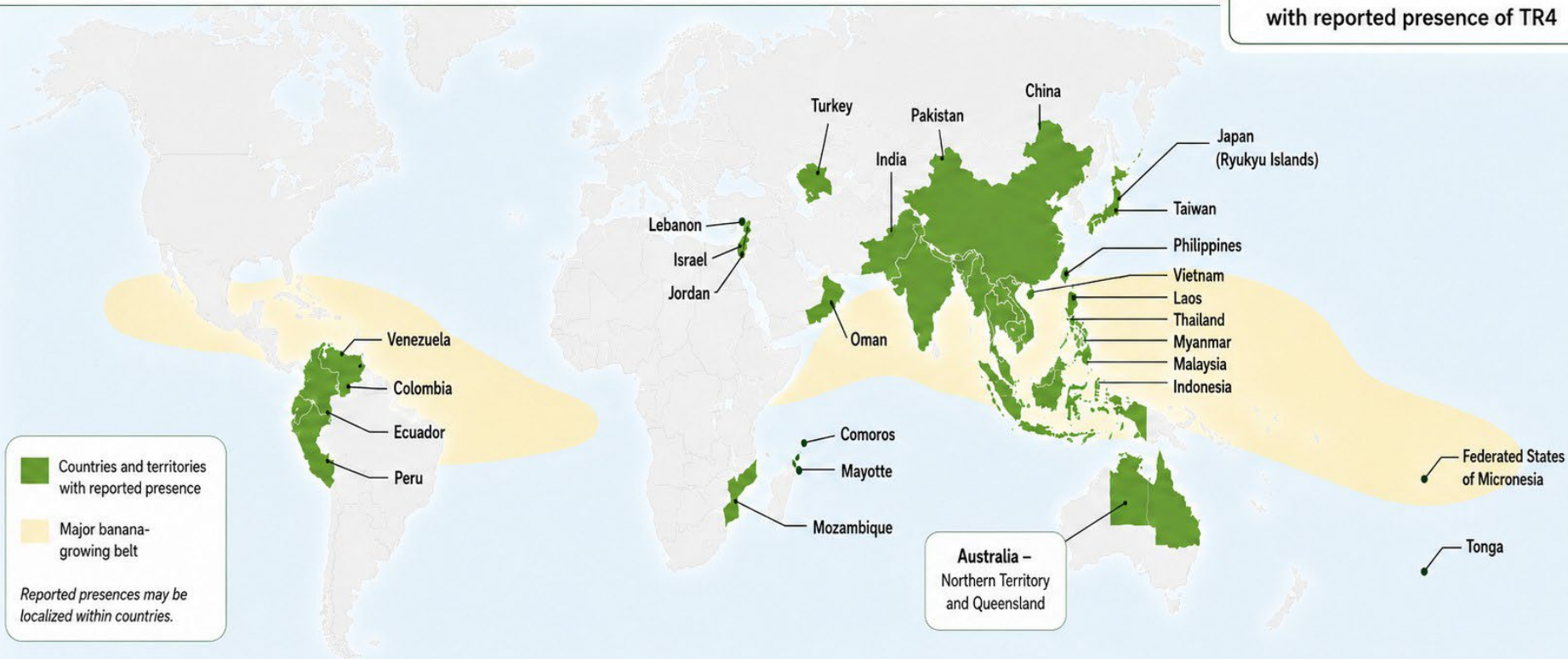


Fusarium wilt Tropical Race 4 (TR4) is a soil-borne fungus that threatens banana production worldwide.



27
countries / territories

with reported presence of TR4



Source: Publication: CABI Compendium, 59074053, <https://doi.org/10.1079/cabicompendium.59074053>

Evolution of Panama disease research in Australia

From the first report in Queensland to integrated risk management in 2026

1874–1947

Discovery and early observations



1953–1987

Cultivar shifts and race 4 awareness



1990–1999

Population biology, diagnostics and soil ecology



1997–2016

TR4 reaches Australia



2019–2026

Integrated systems research and regional action



Why Australia invests

Partners facing TR4 losses

INDONESIA	PHILIPPINES	LAOS
		
 Yield losses  Livelihood risks	 Production decline  Income reduced	 Food insecurity  Farmer stress

-  Knowledge & research flow
→  Benefits & good practices flow



Benefit-Cost
Ratio

71:1



Every \$1 invested
returns \$71

 Protect
Australia's
industry

 Cannot do TR4
field research
in Australia



Learn from
TR4-affected
partners



See what works /
what doesn't



Develop concepts
in Australia



Preliminary
testing in
Australia



Validate with
international
partners



Adapt for
Australian
systems



Food
security



Household
income



Soil
health



Farmer
skills



Regional
cooperation



Biosecurity



Climate
resilience

Regional research protects bananas, livelihoods and biosecurity.

TR4 lessons from Southeast Asia

! What not to do in banana farming *for Australian growers*

TR4 is spreading globally



WE LEARN
FROM
REGIONAL
EXPERIENCE

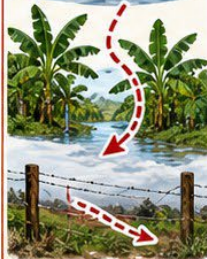
1

Don't bring
TR4 onto the
farm



2

Don't ignore
landscape risk



3

Don't miss
or hide an
incursion



4

Don't create
a disease-
friendly farm



5

Don't rely on
a silver bullet



Regional lessons help protect Australian banana farms.

Farming systems determine the vulnerability



1. Smallholder diverse system



Diverse crops



Diverse cultivars



2. Agroecological banana system



Groundcover



Biodiversity



Resilience



3. Export monoculture system



Efficiency created vulnerability
TR4 exposes it



Genetically simple



Biologically simple



Economically efficient

Increasing vulnerability



A



B



C



**WIDER BANANA SECTOR
& SUPPORT NETWORK**



Working together for healthy
farms and resilient communities.

Beyond blame



Smallholders are often blamed because they are vulnerable—not because they are negligent.

“

When we blame smallholders,
we risk mistaking vulnerability
for negligence.

”

VULNERABILITY FRAMEWORK



Exposure
Hazards and
threats present



Sensitivity
How strongly
people are affected



Adaptive capacity
Ability to cope,
recover and adapt

COMMON CONSTRAINTS



Limited
land



Limited
capital



Limited
technical
support



Limited
finance



Limited
planting
material



Support the grower, strengthen the system.

Better decisions instead of blame



FwIRT helps growers understand risk rather than simply receive advice.



Decision support



Conversation & knowledge exchange



Co-design



Grower ownership



Not compliance



Capacity building



Grounded in integrated disease management



CONVERSATION



EVIDENCE & SCENARIOS

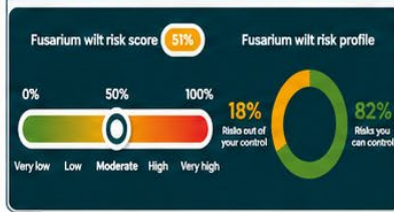


BETTER DECISIONS



Location • Prevention • Protection • Reduction • Resistance • Commitment

FUSARIUM WILT INTEGRATED RISK TOOL (FwIRT)



FOUR SCENARIOS

No threat • Threat • Incursion • Widespread

Disease scenario	Risk of disease incursion	Risk of disease spread and crop loss	Risk of livelihood loss
● ○ ○ ○ No threat	Low	Low	Low
● ● ○ ○ Threat	Medium to high	Low	Low
● ● ● ○ Incursion	High or certain	Medium	Low to medium
● ● ● ● Widespread plant losses	High or certain	High or certain	Medium to high



LISTEN



ASSESS



PLAN TOGETHER



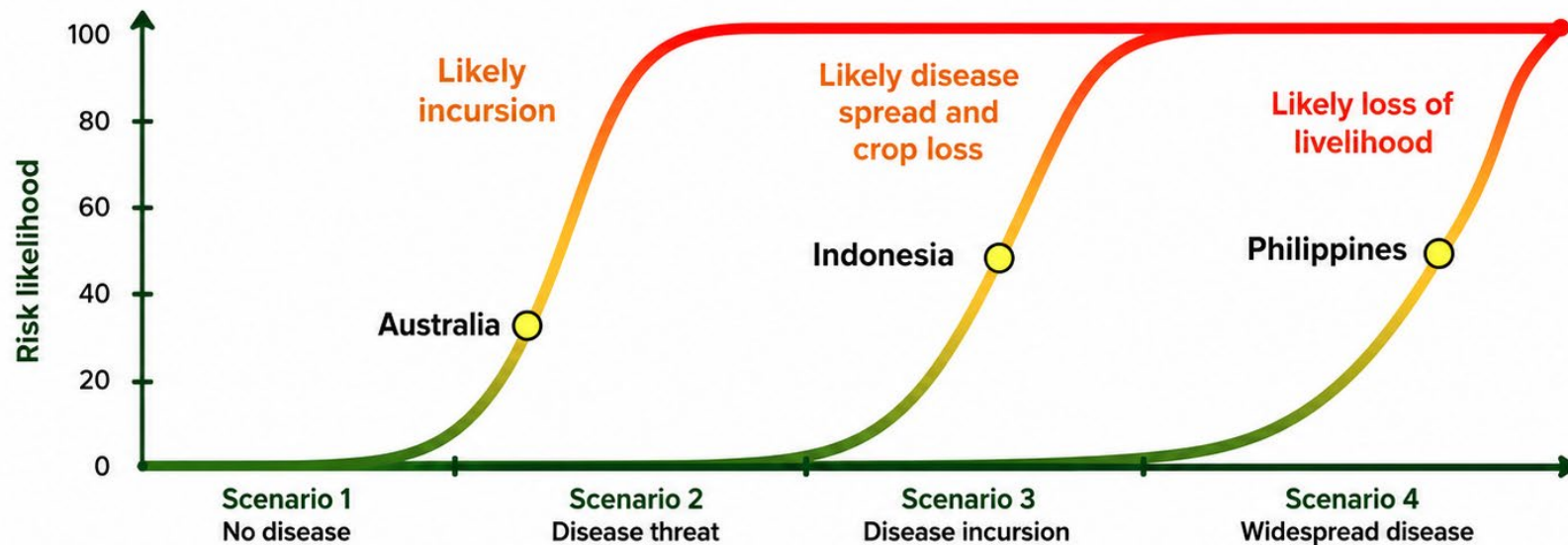
ACT & REVIEW

From risk awareness to practical action



The same disease creates different futures

• Risk is contextual. •



Australia

Commercial banana systems



Indonesia

Smallholder banana systems



Philippines

Integrated banana systems



The tool changes the conversation.



Different farming systems • One framework

The same principles look different in different farming systems.



Australia



Prevention & biosecurity



Location



Prevention



Protection



Reduction



Resistance



Commitment



Mapping & site selection



Clean entry & hygiene



Vehicle & equipment wash



Access control & quarantine



On-farm planning



Pilot studies

- Large commercial farms
- Threat / early stage
- Focus: keep TR4 out

Indonesia



Diverse varieties & adaptation



Location



Prevention



Protection



Reduction



Resistance



Commitment



Variety diversity



Mixed cropping



Adapt to local conditions



Local knowledge & practices



Household-scale management



Pilot studies

- Mixed smallholder systems
- Crop diversity
- Adapt to local context

Philippines



Livelihood recovery through integrated management



Location



Prevention



Protection



Reduction



Resistance



Commitment



Integrated disease management



Livelihood support



Risk reduction



Coordinated action



Recovery & resilience



Pilot studies

- Incursion / widespread
- Integrated system
- Protect crops & livelihoods

Evidence anchor: pilot studies using the Fusarium wilt Integrated Risk Tool (FwiIRT) and MN223 manual.

Arnold Dela Cerna: emerging regional voice

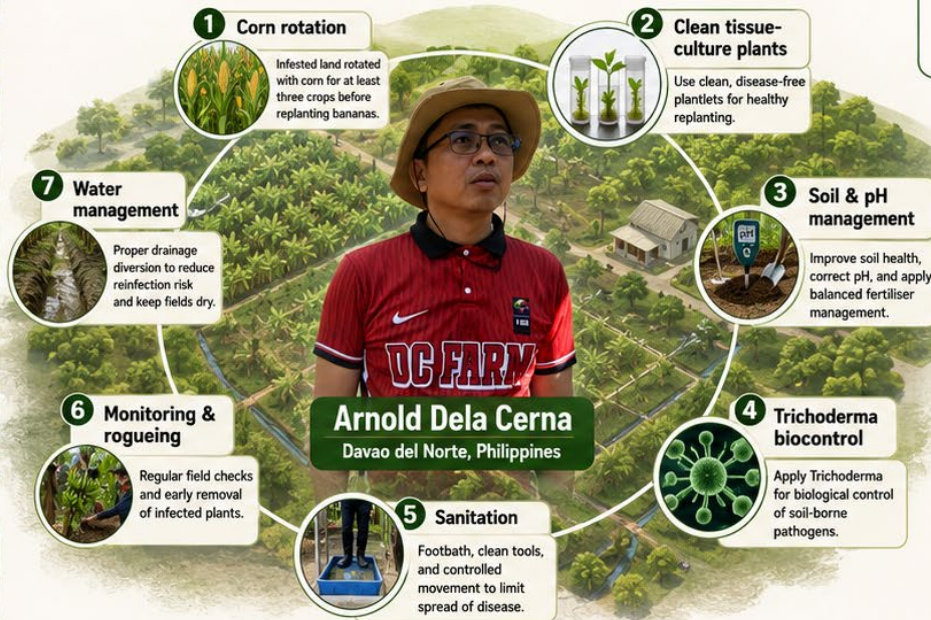
Smallholders are part of the solution.

“His voice may not be heard like a corporation or a publishing scientist, but his practical knowledge gives regional hope.”

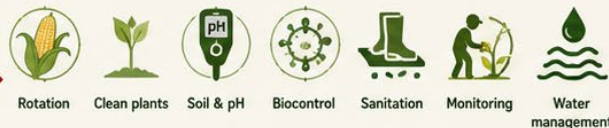
Peer learning



Sharing experiences. Building confidence.
Stronger together.



Integrated management



A connected system protects the farm and builds resilience.

Recovery

Making a comeback



Bigger bunches,
healthier plants.

Crop losses kept lower



Better field health,
more recoverable yield.

Supplying export fruit again



Quality fruit.
Access to premium markets.





Fusarium wilt TR4 – Integrated Risk for Arnold Dela Cerna

From farm-level action to regional leadership

Fusarium wilt risk score **47%**

Fusarium wilt risk profile



12%
Risks out of
your control



88%
Risks you
can control



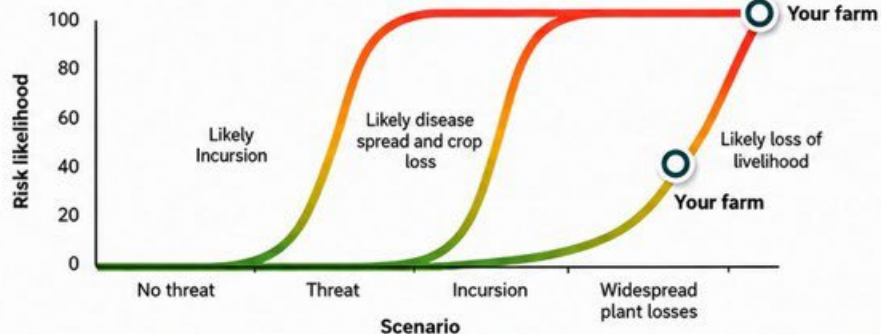
Arnold Dela Cerna

Davao del Norte, Philippines

“ His voice may not be heard like a corporation or a publishing scientist, but his practical knowledge gives regional hope. ”



Fusarium wilt risk progression



Integrated disease management risk

Principle	Low	Medium	High	Comments
Prevention	● ● ●	● ○ ○	○ ○ ○	Your disease prevention practices could be improved
Location	● ● ●	● ● ●	● ○ ○	You have a high inherent risk of Fusarium wilt entering your farm
Protection	● ● ●	● ● ●	○ ○ ○	Your cropping practices could be improved
Reduction	● ● ●	○ ○ ○	○ ○ ○	You are using current best practice
Resistance	● ● ●	● ● ●	○ ○ ○	Use only clean planting material
Commitment	● ● ○	○ ○ ○	○ ○ ○	You are using current best practice

Outcomes of integrated management



Resilient production



Lower crop losses



Better farm income



Stronger livelihoods



Shared knowledge and learning



An emerging regional voice

Arnold's experience shows that smallholder farmers are part of the solution. His success is a model for other communities across the region.



Sharing solutions for stronger, resilient banana systems across Asia.



From farm action to regional impact – building resilient banana systems together.



Australia as a leader

Agroecological disease management of TR4 in bananas



LEADERSHIP FOUNDATIONS



Preparedness

Plans, readiness and biosecurity



Diagnostics

Rapid, accurate testing and capacity



Surveillance

Early detection, targeted monitoring



Industry coordination

Working together for a united response



Practical grower engagement

Trusted advice, on-farm solutions



AUSTRALIA
Leading the way in resilient,
agroecological banana systems

AUSTRALIA CONTINUES TO INNOVATE



Soil biology
Build diverse, living soils



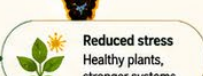
Groundcover
Protect soil, suppress weeds



Organic matter
Feed the soil, improve resilience



Drainage
Manage water, reduce waterlogging



Reduced stress
Healthy plants, stronger systems



Risk tools
Data-informed, better decisions

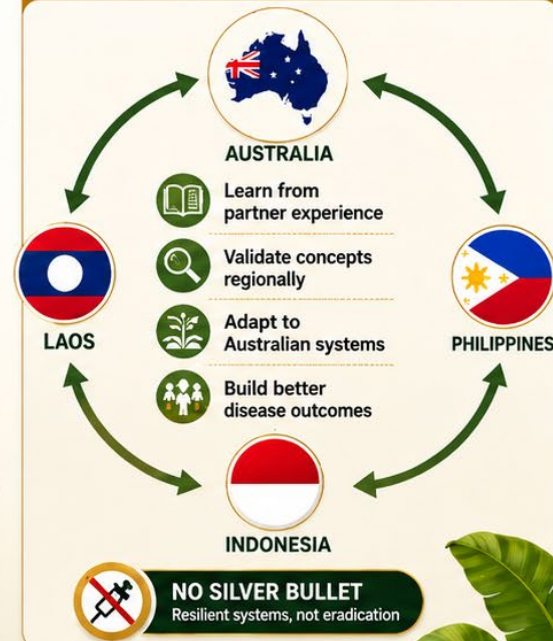


Grower learning
Knowledge sharing, capacity building



Outcome-based management
Measure what matters, improve continuously

LEADERSHIP ALSO MEANS LEARNING Stronger together for better outcomes



LEADER IN PREPAREDNESS, DIAGNOSTICS, SURVEILLANCE AND GROWER ENGAGEMENT —
continuing the transition toward resilient agroecological systems.



Prepared



Informed



Vigilant



Connected



Engaged



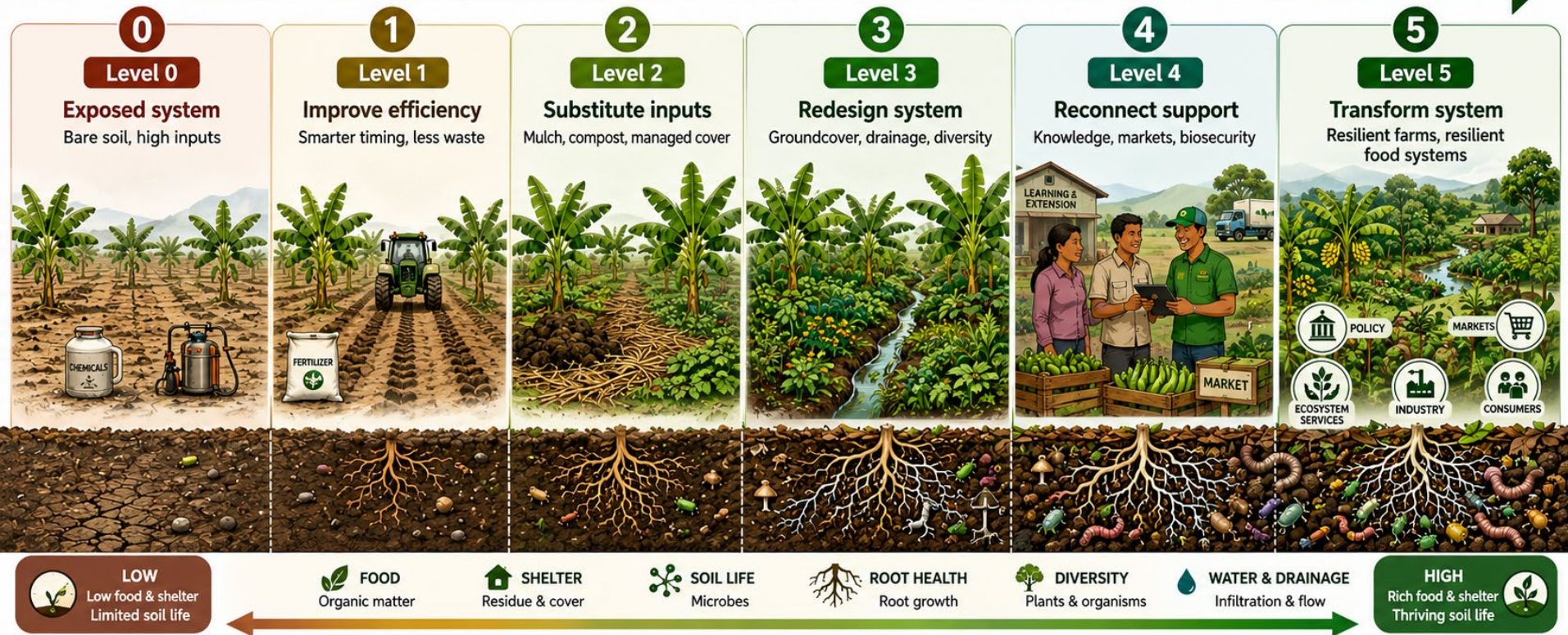
Resilient



Agroecology as a transition pathway

From simplified systems to resilient ecological disease management

TRANSITION: from exposed and simplified → to diverse, soil-protective and market-supported systems



Growers do not jump to resilience — they transition.



No silver bullet — resilience comes from soil biology, organic matter, diversity, drainage and reduced stress.

Agroecological innovators





Agroecological innovations on a banana farm

A conceptual map of biosecurity, biodiversity, family enterprise, ecological markets and risk-informed management

4 Vegetation groundcover under bananas

Living groundcover protects soil, adds organic matter and supports biodiversity.



3 Windbreaks between banana blocks

Tree and shrub windbreaks reduce wind stress, improve microclimate and provide habitat.



2 Roadside vegetation buffer

Native trees, shrubs and grasses filter runoff, reduce dust and improve farm biodiversity.



1 Vehicle & people biosecurity

Quarantine entry, sign-in, vehicle inspection, wash-down and footwear wash help keep our farm Fusarium-free.



5 Family farming enterprise

A family-run farm focused on healthy soils, healthy plants and a sustainable future.



6 Innovation & marketing

Creativity and innovation drive awareness and pride in our ecological banana brand.



7 Connected marketing with an ecological message

From our farm to your home—bananas grown with care for people and planet.



Ecological bananas: healthy soil, healthy fruit.

8 Risk management (Fusarium wilt risk)

Fusarium wilt risk score

27%

0% 50% 100%

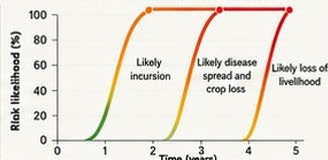
Fusarium wilt risk profile

56%
Risks out of 100 are in the higher range



44%
Risks you can control and reduce

Risk likelihood across scenarios



9 Validation & testing (Soil health)

Soil Health Test Summary

Indicator	Status	Score (0-100)
Soil Physical Health	Good	75
Soil Biological Health	Good	65
Soil Chemical Health	Good	55
Overall Soil Health	Good	65

What it means



Good soil health supports resilient plants, higher yields and long-term viability.

Legend

- 1 Vehicle & people biosecurity
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Windbreaks (trees/shrubs)



Roadside buffer



Footwear wash station



Controlled entry



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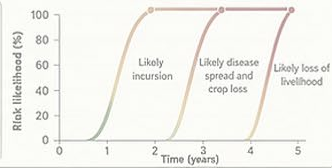
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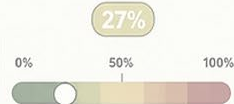
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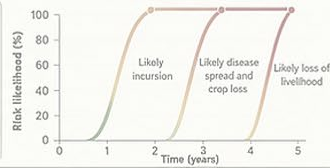
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Roadside buffer



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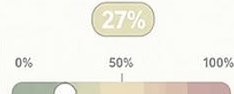
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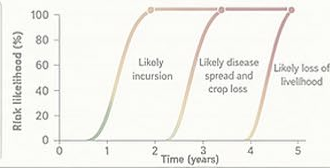
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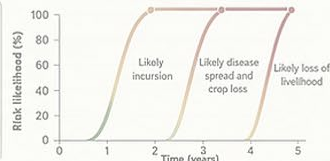
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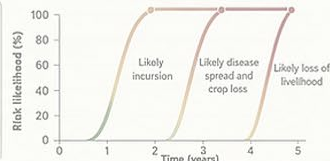
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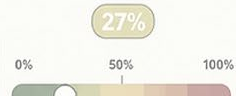
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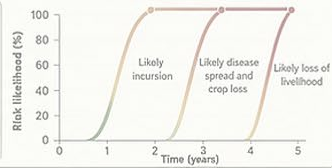
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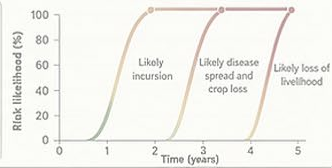
Fusarium wilt risk score



Fusarium wilt risk profile



Risk likelihood across scenarios



9 Validation & testing (Soil health)

Soil Health Test Summary

Indicator	Status	Score (0-100)
Soil Physical Health	Good	75
Soil Biological Health	Good	65
Soil Chemical Health	Good	55
Overall Soil Health	Good	65

What it means

Good soil health supports resilient plants, higher yields and long-term viability.

Legend

- 1 Vehicle & people biosecurity
- 2 Roadside vegetation buffer
- 3 Windbreaks between banana blocks
- 4 Vegetation groundcover under bananas
- 5 Family farming enterprise
- 6 Innovation & marketing
- 7 Connected marketing



Windbreaks (trees/shrubs)



Roadside buffer



Footwear wash station



Controlled entry



Agroecological innovations on a banana farm

A conceptual map of biosecurity, biodiversity, family enterprise, ecological markets and risk-informed management

4 Vegetation groundcover under bananas

Living groundcover protects soil, adds organic matter and supports biodiversity.



3 Windbreaks between banana blocks

Tree and shrub windbreaks reduce wind stress, improve microclimate and provide habitat.



2 Roadside vegetation buffer

Native trees, shrubs and grasses filter runoff, reduce dust and improve farm biodiversity.



1 Vehicle & people biosecurity

Quarantine entry, sign-in, vehicle inspection, wash-down and footwear wash help keep our farm Fusarium-free.



5 Family farming enterprise

A family-run farm focused on healthy soils, healthy plants and a sustainable future.



6 Innovation & marketing

Creativity and innovation drive awareness and pride in our ecological banana brand.



7 Connected marketing with an ecological message

From our farm to your home—bananas grown with care for people and planet.



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8 Risk management (Fusarium wilt risk)

Fusarium wilt risk score

27%

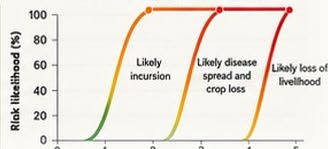
Fusarium wilt risk profile

56% Risks out of 100 are in the higher range



44% Risks you can control and reduce

Risk likelihood across scenarios



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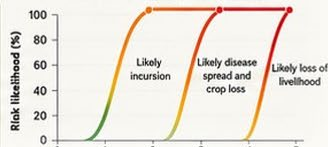
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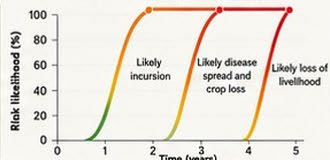
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Controlled entry

From blame to building capacity

A more positive pathway for managing Fusarium wilt TR4



The message

Past:

History tells us what not to do



TR4 cannot be managed by blaming smallholder growers or relying on one solution



A regional risk framework must recognise biological, social and economic vulnerability



The recommendation

Present:

Decision support and shared knowledge lead to better outcomes



Two-way knowledge exchange



Understand risks and outcomes



Build knowledge and understanding



The opportunity

Future:

Agroecological principles build resilience before the next crisis



Move from simplified, exposed systems



Toward diverse, soil-protective, resilient banana systems



Support household livelihoods



ACKNOWLEDGEMENTS

Thank you to our funders, collaborators and the scientific community

FUNDING PARTNERS



ACIAR

Australian Centre for
International Agricultural
Research

**Hort
Innovation**

Strategic levy investment
for Australian horticulture



**Queensland
Government**

Department of Primary
Industries



**THE UNIVERSITY
OF QUEENSLAND**
AUSTRALIA

CREATE CHANGE



Investing in
soil biology
for sustainable and
productive banana systems



**THE
Crawford
Fund**
FOR A FOOD
SECURE WORLD

COLLABORATORS AND RESEARCH PARTNERS



Australia

- University of Queensland
- Queensland Department of Primary Industries
- Centre for Wet Tropics Agriculture

Africa

- Stellenbosch University, South Africa
- Bioversity International – CIAT, Uganda

Philippines

- University of Southeastern Philippines

Southeast Asia

- Universiti Putra Malaysia
- Universiti Malaya
- Department of Agriculture, Lao PDR

IN KIND AND TECHNICAL SUPPORT



Laboratory, sequencing and bioinformatics support from The University of Queensland



Technical support from project team members and students



Access to field sites, plant material and local knowledge



Special thanks to all project staff, students and collaborators

GROWER ACKNOWLEDGEMENT



We gratefully acknowledge and thank banana growers in Australia, Laos, Indonesia and the Philippines for their invaluable support, collaboration and local knowledge that make this research possible.

Together, developing knowledge to build resilient soils and healthy banana systems.

Thank you!





TR4 Knowledge exchange



Australian Centre
for International
Agricultural Research



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

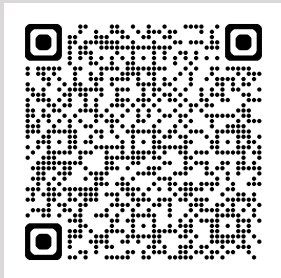
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FOR QUEENSLAND



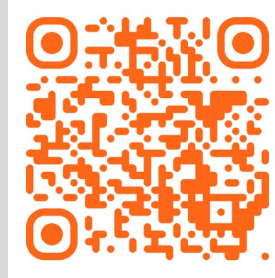
Queensland
Government

- **Next Webinar:** 18 August 2026, 2:00 -2:45 pm
- **Topic:** How Landscapes Shape Disease
- **Question:** How do surrounding land uses influence pathogen risk?

Join a webinar



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