Development of biocontrol agents to manage major diseases of tropical plantation forests in Indonesia: A review

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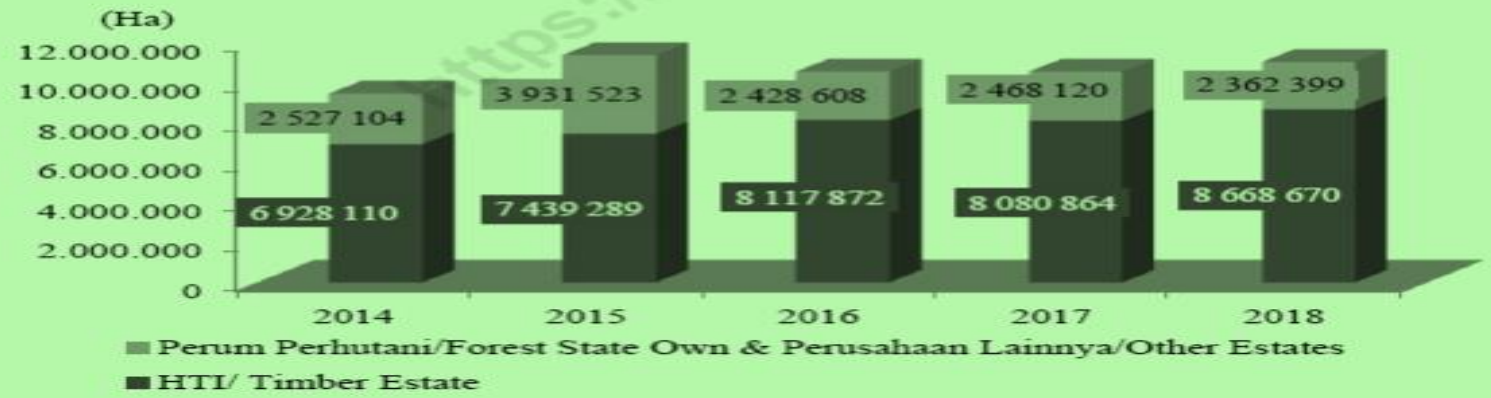
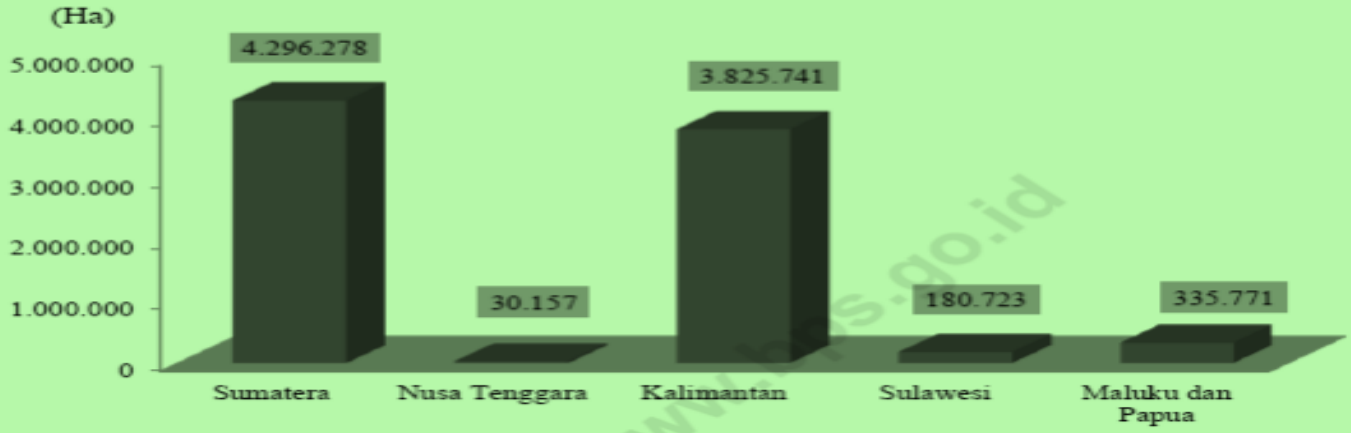
Plantation forests: Land areas

(BPS 2019)

Gambar / *Figure* 1. Luas lahan yang dikuasai Perusahaan Pembudidaya Tanaman Kehutanan (Ha), 2014 - 2018
Land Area Held by Timber Culture Establishment (Ha), 2014 - 2018

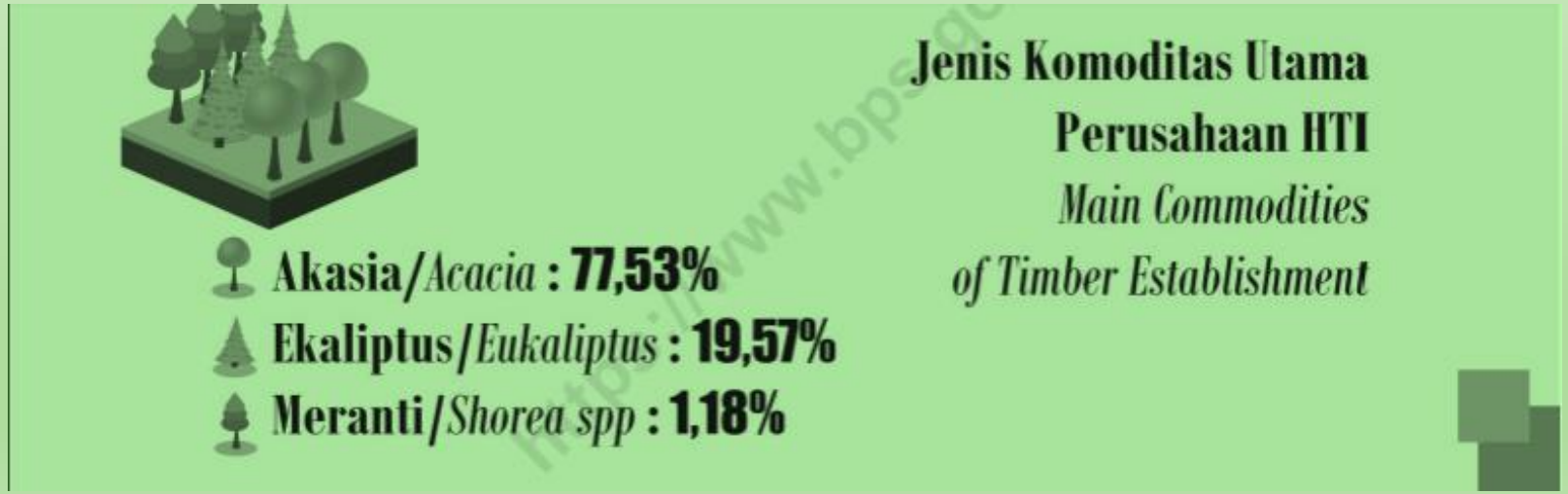


Gambar / *Figure* 2. Luas Lahan yang Dikuasai Perusahaan HTI Menurut Pulau (Ha), 2018
Land Area Held by Timber Establishments by Island, (Ha) 2018



Plantation forests: Log production and contribution

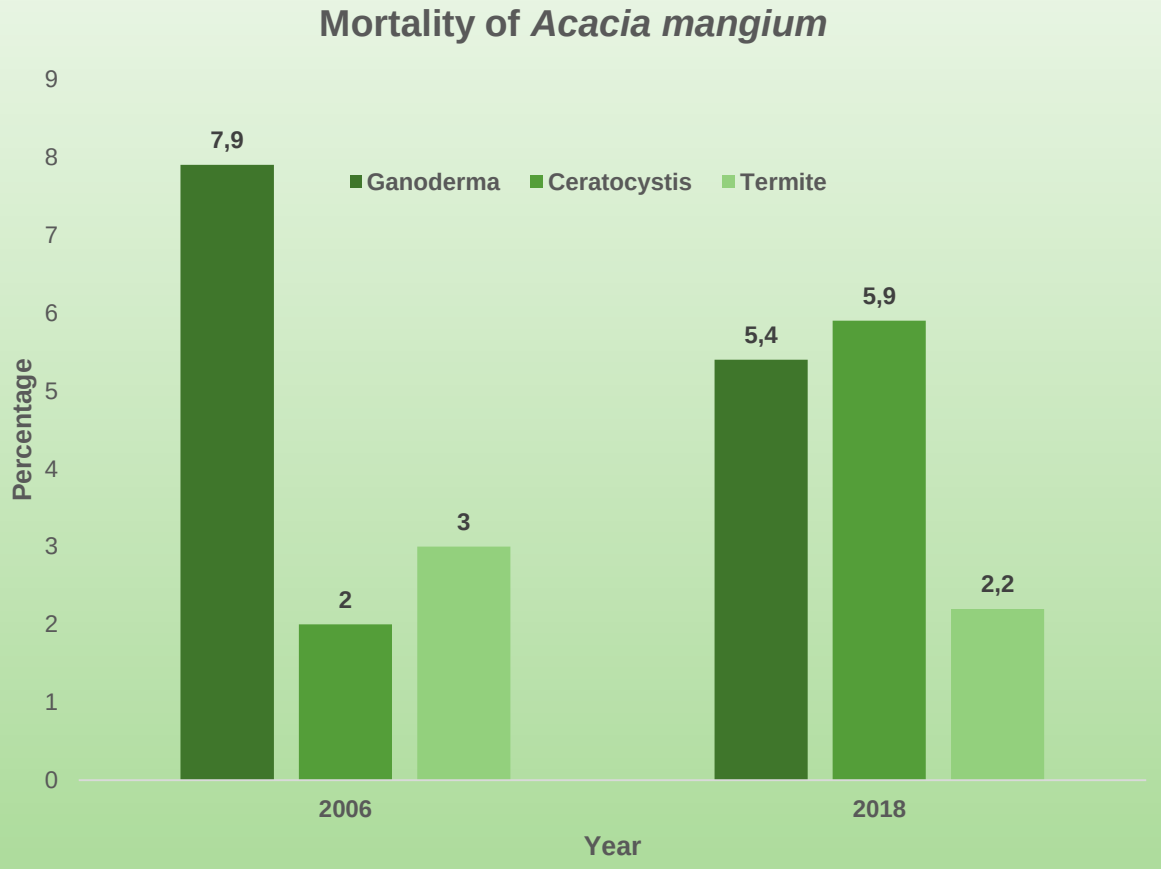
(BPS 2019)



In 2018, Forestry Sector contributed USD 12,17 Billion to the country's income (http://ppid.menlhk.go.id/siaran_pers/browse/1724).

Red root rot on *Acacia mangium*: Significance

- In Indonesia (3-5 years) 2nd-rotation plantations incidence is 3-28 % (Irianto et al., 2006).
- In the Philippines (6-10 years), mortality is 10-25 % (Militante and Manalo, 1999).
- In India (9-14 years), mortality is ~40 % (Mehrotra et al., 1996).
- In Malaysia (14 years), mortality is up to 40 % (Lee, 2000).



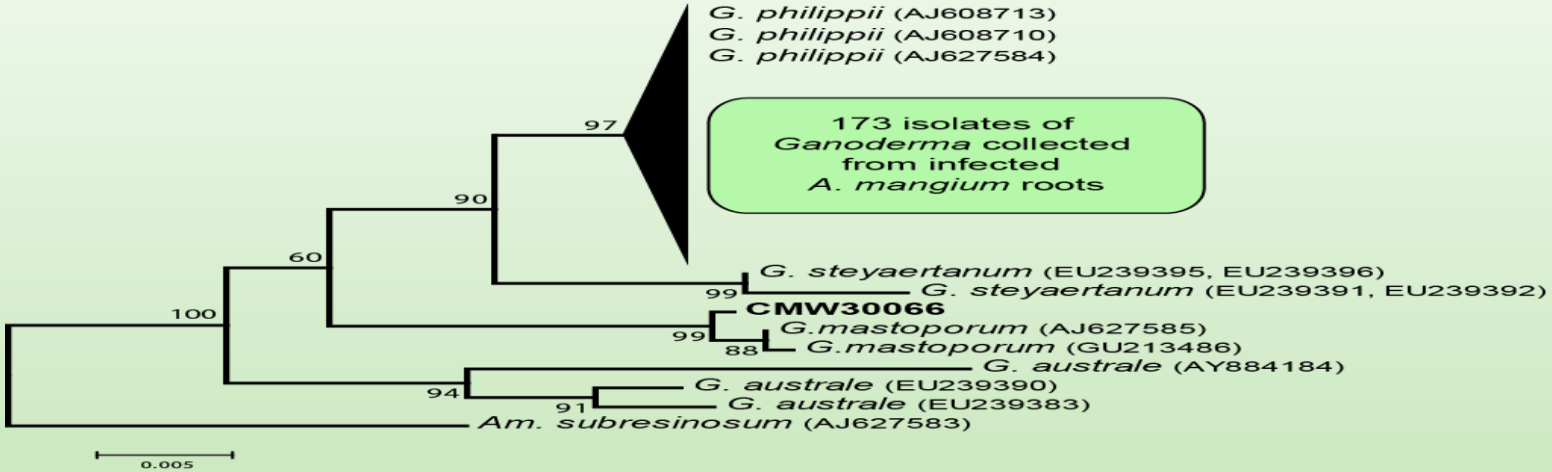
Forest Pathology
WILEY-BLACKWELL
For. Path. 44 (2014) 447–459

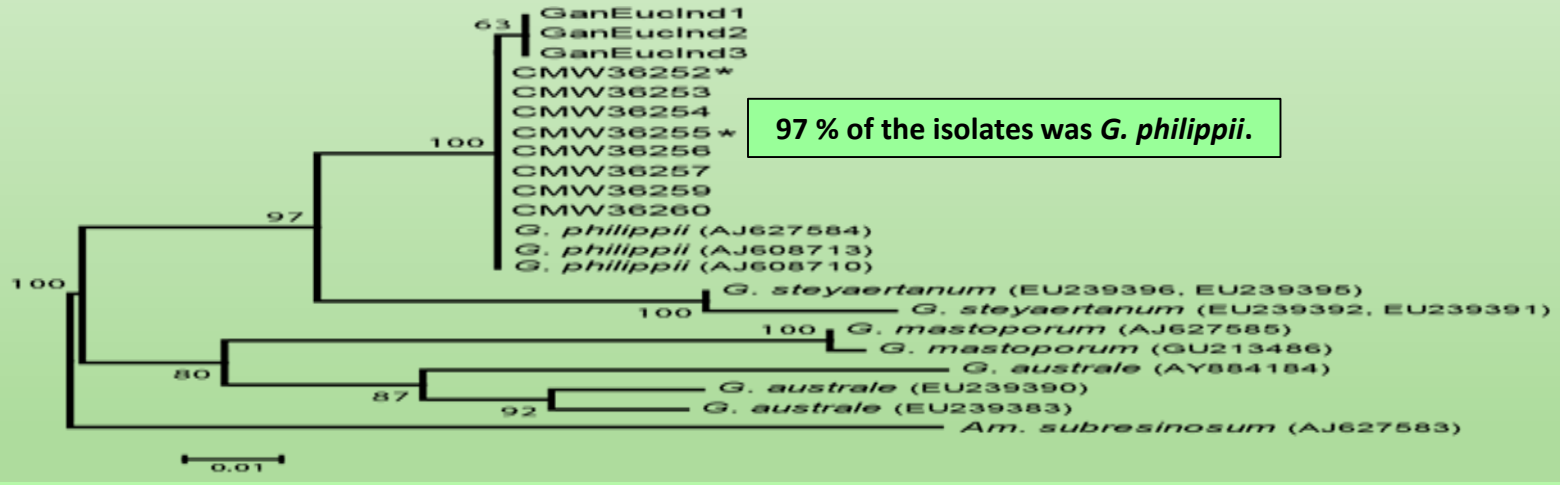
doi: 10.1111/efp.12141

Disease progression in plantations of *Acacia mangium* affected by red root rot (*Ganoderma philippii*)

By A. Francis[1], C. Beadle[1,2], D. Puspitasari[3], R. Irianto[4], L. Agustini[4], A. Rimbawanto[3], A. Gafur[5], E. Hardiyanto[6], Junarto[7], N. Hidyati[3], B. Tjahjono[5], U. Mardai[8], M. Glen[1] and C. Mohammed[1,9]

Red root rot in plantation forests: Pathogen





97 % of the isolates was *G. philippii*.

Southern Forests: a Journal of Forest Science

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tsfs20

A single dominant *Ganoderma* species is responsible for root rot of *Acacia mangium* and *Eucalyptus* in Sumatra

M PA Coetzee [a] , B D Wingfield [a] , G D Golani [b] , B Tjahjono [b] , A Gafur [b] & M J Wingfield

Red root rot in plantation forests: Pathogen

- ***Ganoderma philippii*** **is the dominant pathogen of root rot diseases in plantation forests in Indonesia.**
- **Other fungi isolated include *G. mastoporum, Phellinus noxius*, *Tinctoporellus epimiltinus*, and *Rigidoporus microporus*.**

Forest Pathology WILEY-BLACKWELL

For. Path. 44 (2014) 496–508
doi: 10.1111/efp.12146

Identification of basidiomycete fungi in Indonesian hardwood plantations by DNA barcoding

By M. Glen[1,6], V. Yuskianti[2], D. Puspitasari[2], A. Francis[1], L. Agustini[3], A. Rimbawanto[2], H. Indrayadi[4], A. Gafur[5] and C. L. Mohammed[1]

Challenge

1 kg of prevention

is better than

1 ton of cure.

Utilization of resistant genotypes

Southern Forests: a Journal of Forest Science

Publication details, including instructions for authors and subscription information:
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A new screening method for Ganoderma philippii tolerance in tropical Acacia species

Abdul Gafur[a], Aswardi Nasution[a], Muhammad Yuliarto[a], Wong Ching Yong[a] & Mukesh Sharma[a]

Root rot biocontrol: *Gliocladium* and *Trichoderma*

Root Rot Pathogen	Biocontrol Agent	*In Vivo* or *In Situ*	Reference
Ganoderma lucidum	*Trichoderma harzianum*	*In vitro*	Bhaskaran (2000)
Ganoderma boninense	*Trichoderma harzianum*	*In vitro*	Dharmaputra et al. (1989)
	Trichoderma spp.	*In situ*	Soepena et al. (2000)
	Gliocladium viride	*In situ*	Susanto et al. (2005)
Ganoderma spp.	*Trichoderma* spp.	*In vitro*	Widyastuti (2006)
Phellinus weirii	*Trichoderma viride*	*In situ*	Nelson et al. (1995)
Armillaria sp.	*Trichoderma polysporum, T. harzianum*	*In situ*	Berglund and Ronnberg (2004)
	Trichoderma sp.	Both	Hagle and Shaw (1991)
	Trichoderma harzianum, T. viride, T. hamatum	Both	Raziq and Fox (2006)

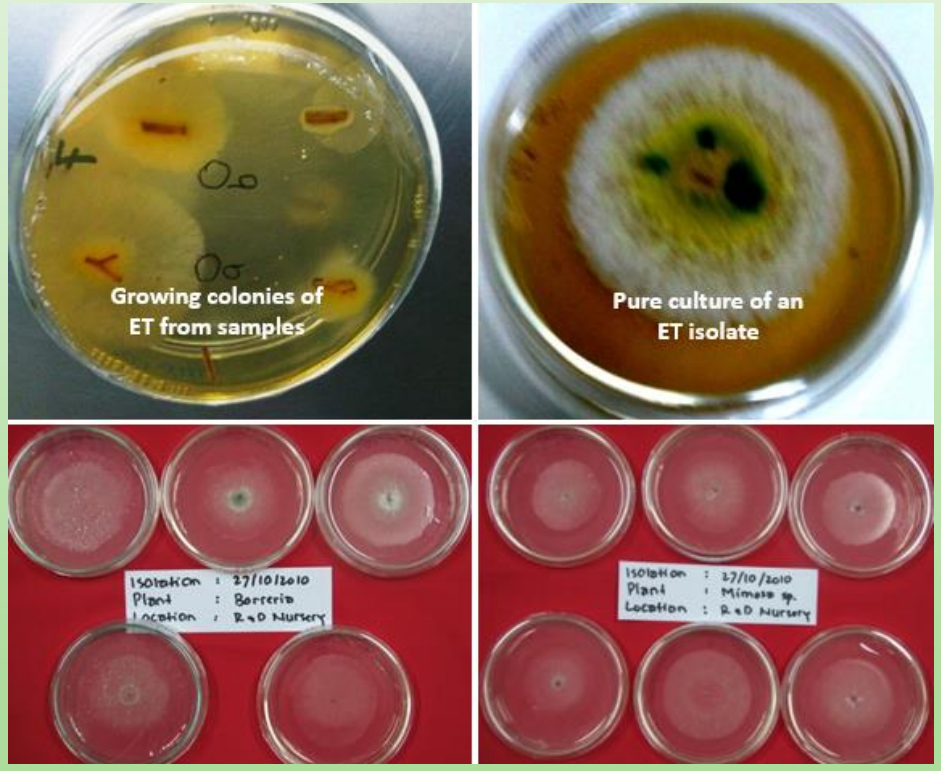
Free-living (rhizospheric) *Trichoderma*

(Gafur et al. 2011a; 2011b)

- **Free-living *Trichoderma* isolates lack consistency in the field. Isolates with excellent inhibitory effects in laboratory tests, may not be a good performer in the field.**
- **In addition, they are not necessarily equally good in different environments.**

Endophytic *Trichoderma* (ET)

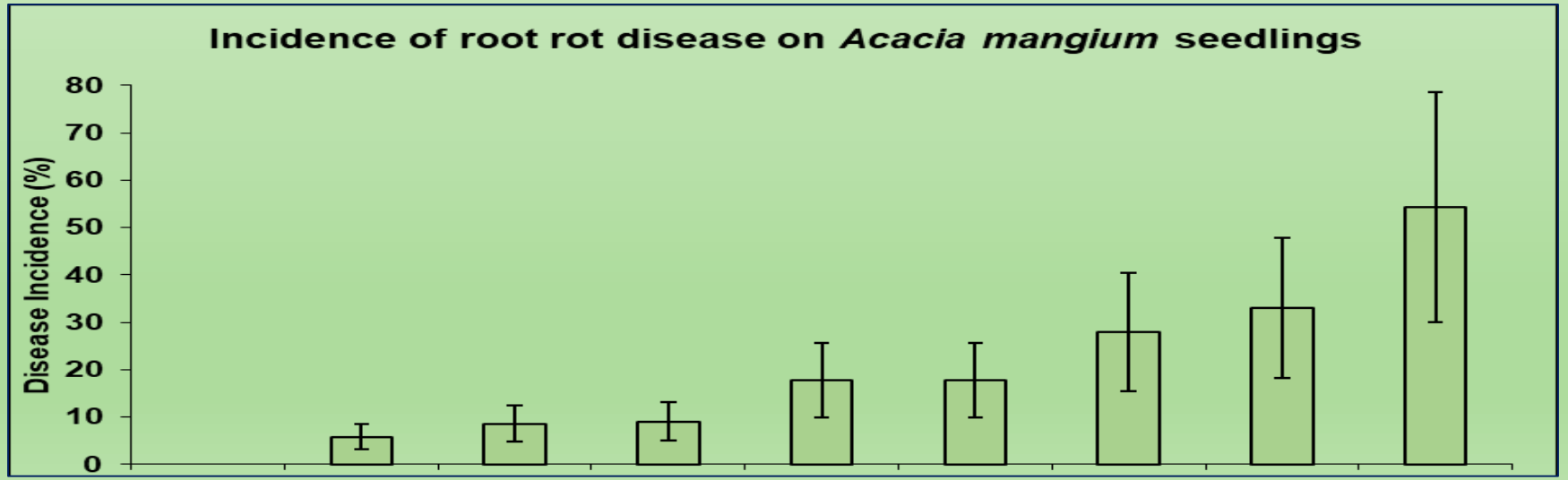
(Gafur et al. 2015a)



- **Endophytic *Trichoderma* may persist in the root of host plants through the rotation, providing hope for future disease management.**
- **More than 200 isolates of endophytic *Trichoderma* from different 33 plant species are isolated from a range of ecosystems. The collection cultures morphologically varies. They are subjected to nursery screening trials for future possible commercial seedling inoculation.**

ET nursery screening trial

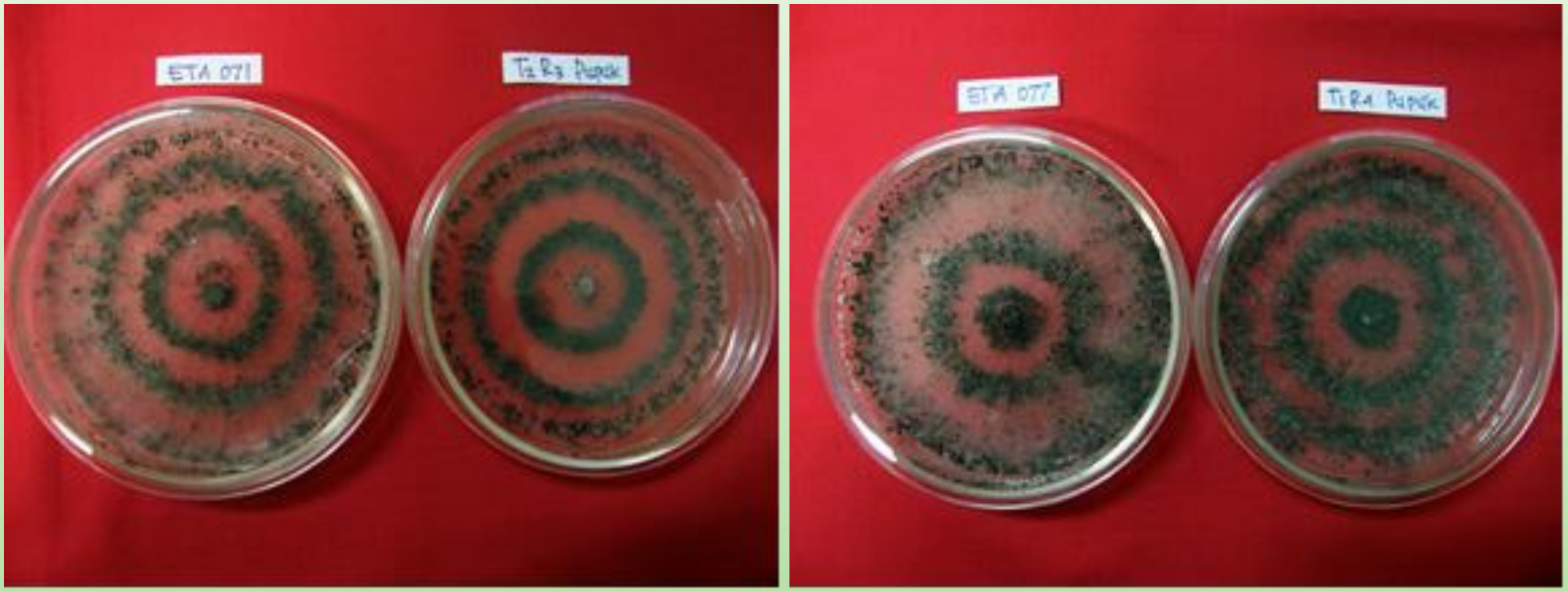
(Gafur et al. 2015a)



Different isolates of endophytic *Trichoderma*

ET re-isolation from roots of treated plantations

(Gafur et al. 2015a)



A **B**

Colonies of isolates A and B originated from laboratory pure culture (left) and *Acacia mangium* root isolation (right).

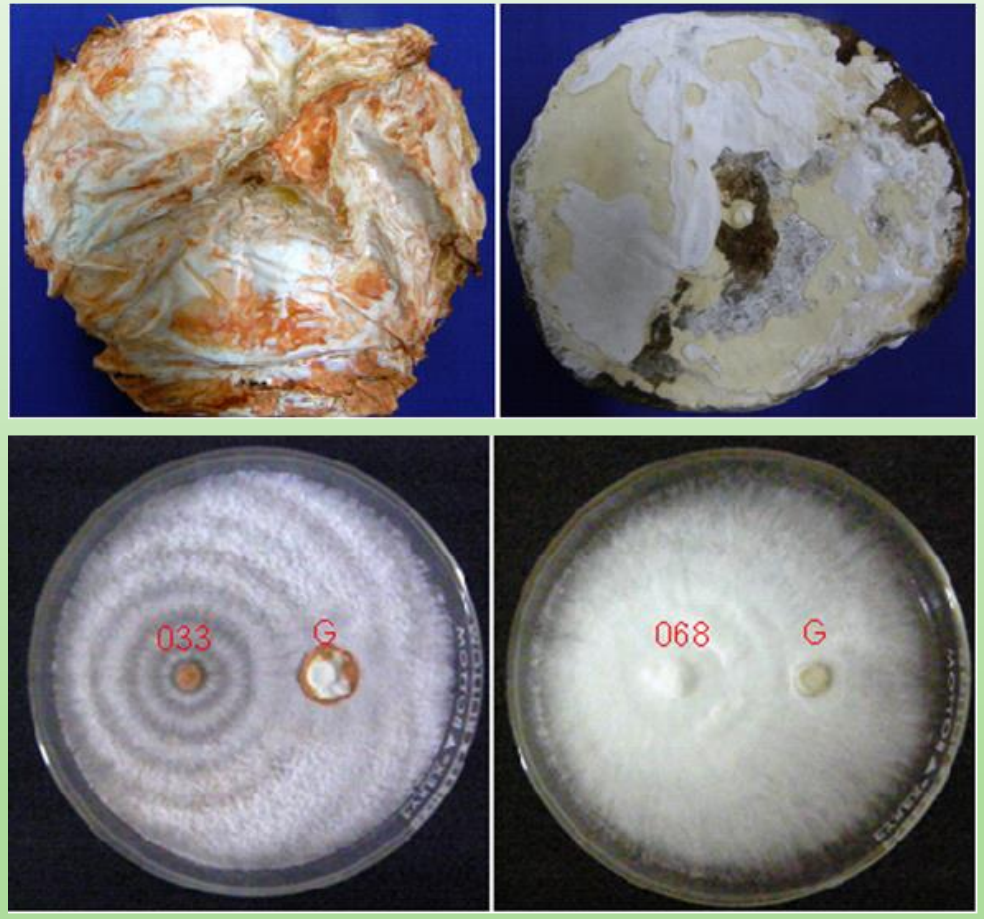
Root rot biocontrol: *Phlebiopsis* and *Cerrena*

(Nurrohmah et al. 2019)

- ***Phlebiopsis gigantea*** **is widely used to control** ***Heterobasidion annosum*****.**
- **In vitro tests reveal antagonism of** ***Phlebiopsis*** **and** ***Cerrena*** **against** ***Ganoderma*** **and** ***Phellinus*****.**
- **They are then applied onto stumps to prevent colonization by the pathogens.**

Root rot biocontrol: Other white rot fungal species

(Sitompul et al. 2011)



- **107 samples are collected from various origins and localities in Sumatra.**
- **Of the 107 samples, 79 are isolated (51 samples were from fruiting bodies, 28 from rotten woods).**
- **The newly isolated fungi then undergo three screening processes using wood block, wood disc, and culture medium.**

BWD biocontrol: Endophytic bacteria

- **Bacterial wilt disease (BWD) has emerged as an economically important disease of eucalypt plantations in Indonesia.**
- **A consortium of endophytic bacteria has been developed to manage BWD.**
- **The product reduces disease risk and prolongs incubation period.**

Conclusions

1. **Pests and diseases are likely to continuously challenge plantation forests in Indonesia.**
2. **As one key component of integrated disease management, biocontrol agents provide a significant contribution to the effort.**
3. **Development of effective biological controls should focus more on consortium of locally more adapted and compatible microorganisms.**
4. **Introduction of endophytic microbes into the scenario should be encouraged.**

Acknowledgements

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- PT MHP, Indonesia
- PT RAPP, Indonesia
- University of Tasmania, Australia

Thank you,
stay safe and healthy!

#tanamansehatIndonesiakuat!