Epidemiology and Presdisposing Factors of *Ganoderma* Basal Stem Rot

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OUTLINE

1. Introduction
2. Oil Palm & Diseases
3. *Ganoderma* Basal Stem Rot
4. Epidemiology
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INTRODUCTION

Malaysian Palm Oil Board

- Formed in 1979 as Palm Oil Research Institute of Malaysia (PORIM)
- MPOB established on 1st May 2000
- Merger between Research Department (PORIM) and Licensing Unit (PORLA)
- Custodian of oil palm – research in upstream, midstream and downstream

Plant Pathology & Biosecurity Unit

2 Groups
- Integrated *Ganoderma* Management (IGM)
- Emerging & Exotic Diseases (EDB)

Applied and Fundamental Research on *Ganoderma* and other emerging diseases

Oil palm

- ✓***Elaeis guineensis* Jacq.**
- ✓An important **commodity crop** in Malaysia
- ✓Planted **5.6 million hectarage**
- ✓Contribute approximately **60 billion export revenue** (Parveez et al., 2024)
- ✓Vulnerable to several diseases
- ✓**Thirty-two** diseases and disorders affects the oil palm in Africa, Southeast Asia, and South America
- ✓Confined to the region planted

MAJOR OIL PALM DISEASES

Local disease

Basal Stem Rot Disease

Exotic diseases

Bud Rot Disease

Vascular Wilt Disease

OIL PALM DISEASES IN MALAYSIA

Field diseases

Basal Stem Rot disease

Nursery Diseases

Leaf Spot disease

Anthracnose disease

Seed Diseases

Biji benih yang dijangkiti dilitupi dengan miselium putih

Biji benih dijangkiti dengan miselium putih dan bintik kehijauan (spora)

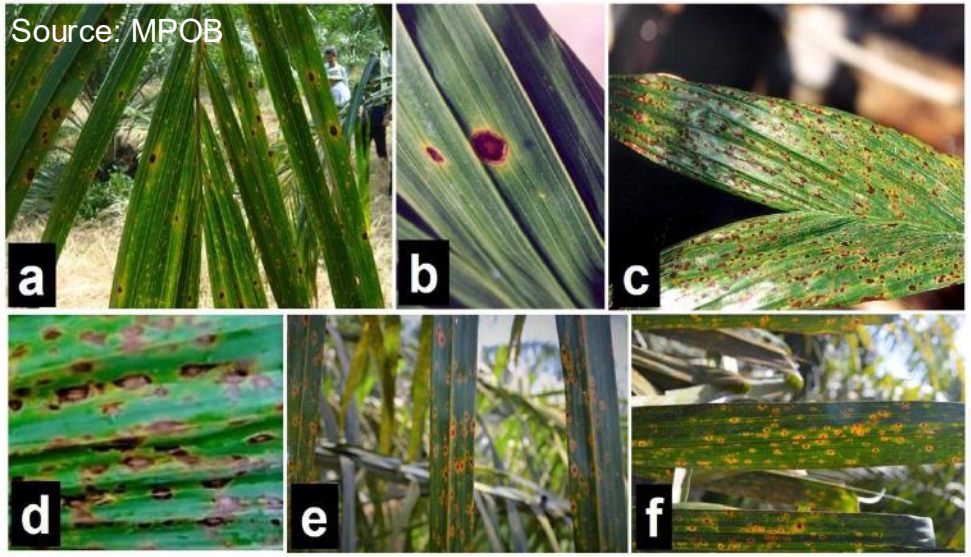
EMERGING DISEASES IN MALAYSIA

Algae leaf spot

Sooty Mold

Stem Wet Rot

Leaf spot



Bunch Rot

Ganoderma Basal Stem Rot

- The deadliest disease affecting oil palm industry in Malaysia and Indonesia
- Yield limiting with significant number of palm losses

History of *Ganoderma* basal stem rot (BSR) disease

1915 The BSR disease was described in Republic of Congo, West Africa

1931 Thompson detected the disease infecting oil palms over 25 years in Malaysia but on old palms due to replanting

1960s BSR incidence increases and infects younger palms (10-15 years old)

In the initial years of planting….

Ganoderma found to be infecting replanted oil palms as early as 12 – 24 months

Replanted areas

Areas underplanted and previous coconut palms

(Ariffin *et al*. 1996)

Ganoderma Basal Stem Rot (BSR)

G. boninense

Most aggressive

G. zonatum

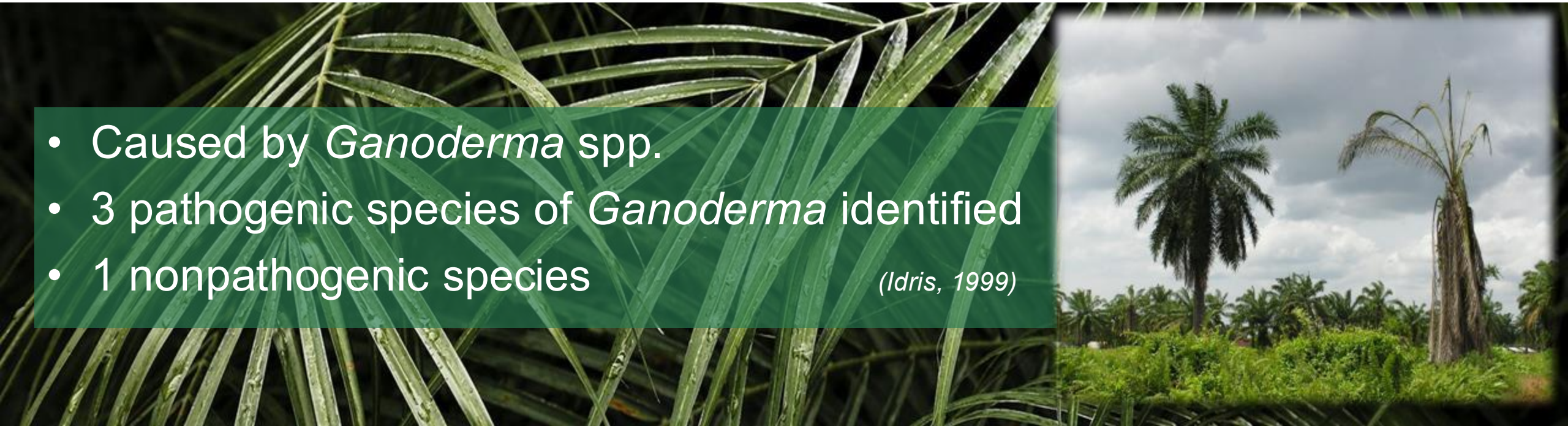
Moderately aggressive

G. miniatocinctum

Least aggressive

G. tornatum

Non-pathogenic



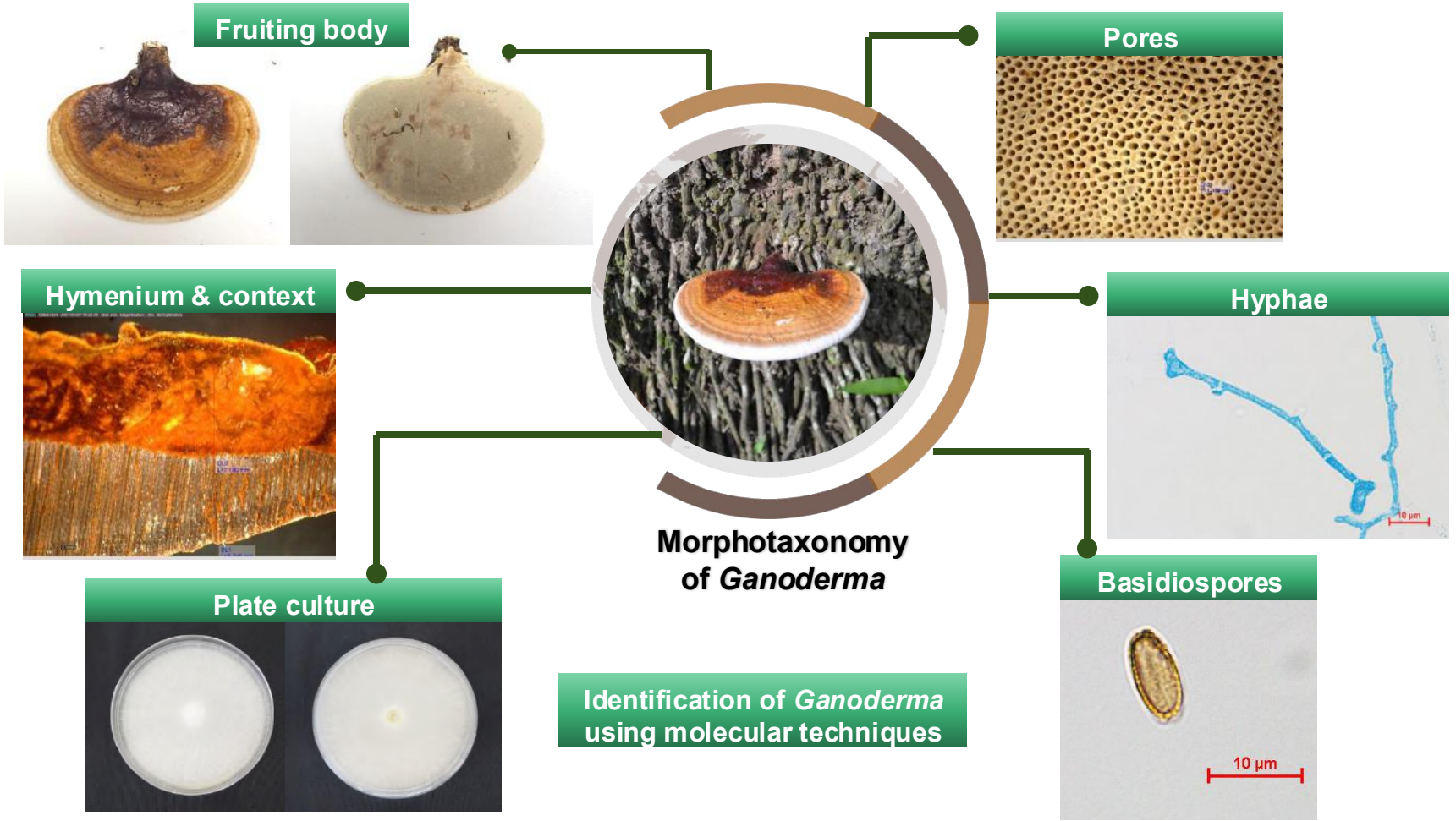
- Caused by *Ganoderma* spp.
- 3 pathogenic species of *Ganoderma* identified
- 1 nonpathogenic species

(Idris, 1999)

Pathogen: *Ganoderma boninense?*

Updating the systematics of *Ganoderma* spp

- sampled > 500 sporophores
- recorded demographic data of the sampled palms
- identification based on:
  i. Morphotaxonomy
  ii. DNA (ITS)
  iii. Gene
- first portal for *Ganoderma* to archive scientific information – GanoID
-



Sundram et al (in press)

Epidemiology of *Ganoderma* Basal Stem Rot

Prevalence of *Ganoderma* Basal Stem Rot Incidences *(Shukri et al., 2020)*

1.51%

Survey *Ganoderma* 1994-1995
Infected– 1.51%.
Number of estates with *Ganoderma* – 268.
Area – 31,197 ha.

3.71%

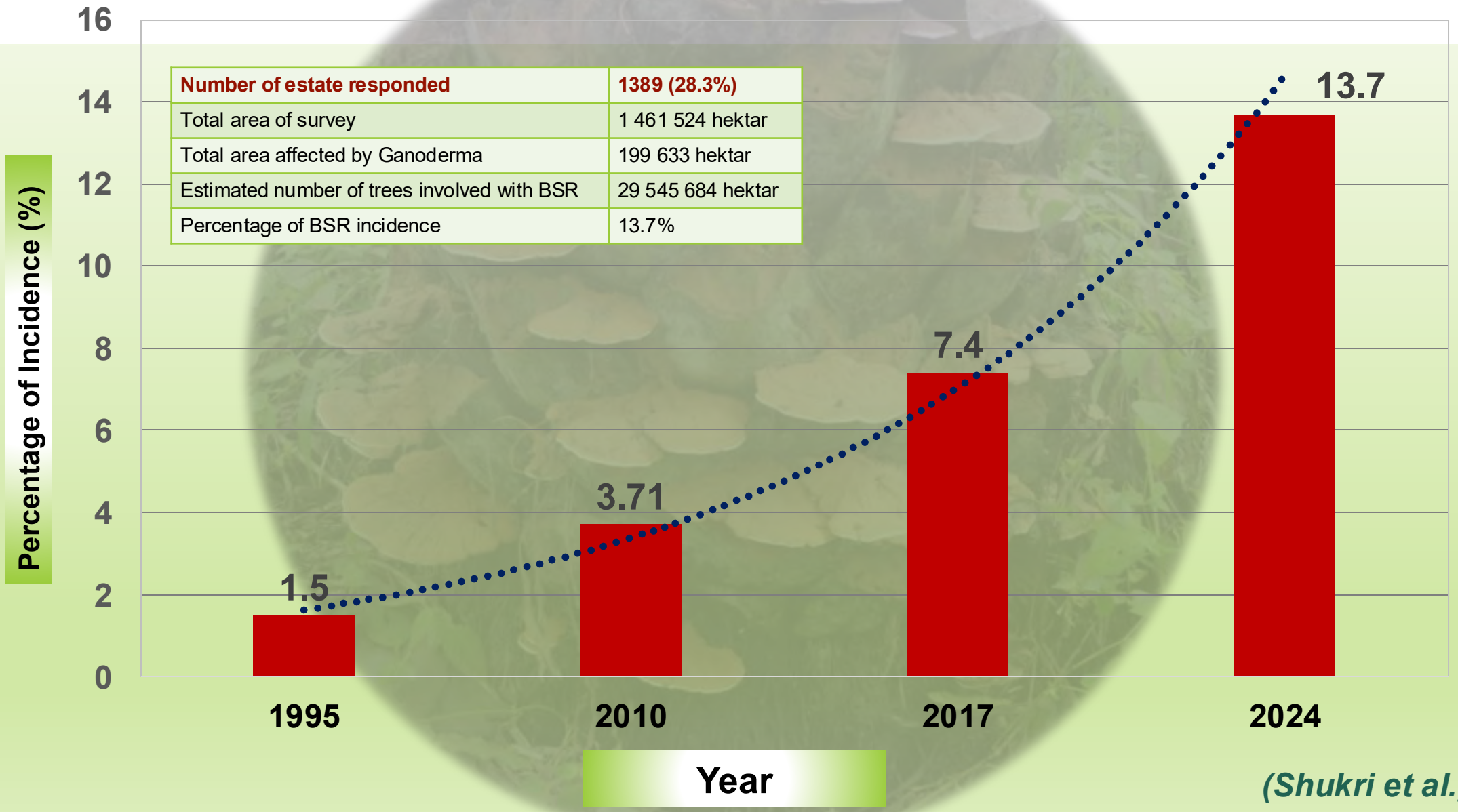
Survey *Ganoderma* 2009-2010
Infected– 3.71%.
Number of estates with *Ganoderma* – 632.
Area – 59,148 ha.

7.4%

Survey *Ganoderma* 2017-2018
Infected– 7.4%.
Number of estates with *Ganoderma*– 1279.
Area – 221,000.0 ha

Ganoderma Basal Stem Rot Disease Incidences in Malaysia (1995 - 2024)

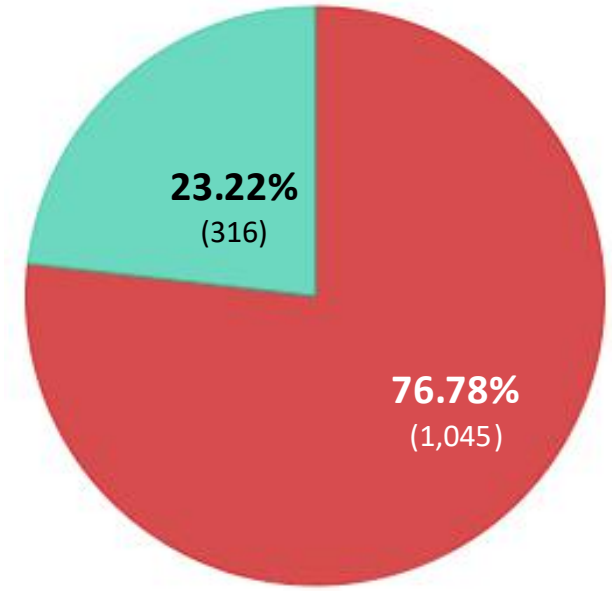
Number of estate responded	**1389 (28.3%)**
Total area of survey	1 461 524 hektar
Total area affected by Ganoderma	199 633 hektar
Estimated number of trees involved with BSR	29 545 684 hektar
Percentage of BSR incidence	13.7%



(Shukri et al., 2025)

TREATMENT/MANAGEMENT OF *Ganoderma* BSR DISEASE

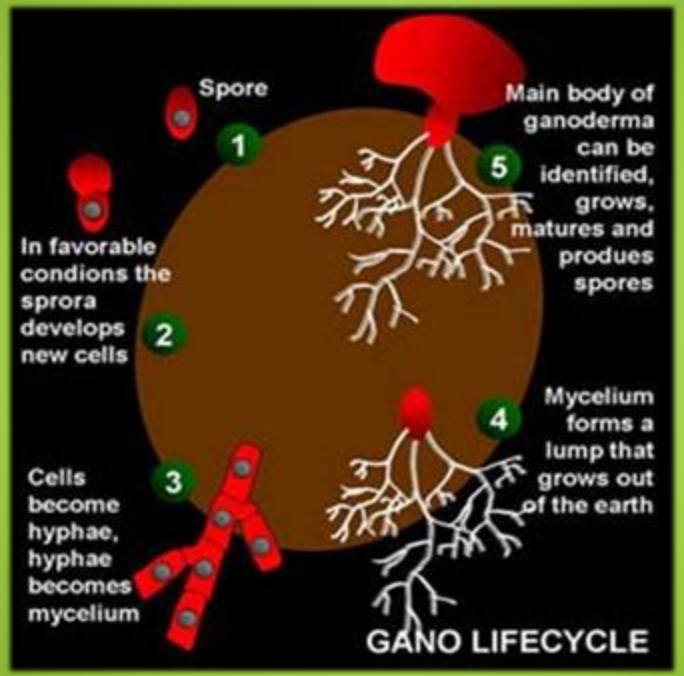
MALAYSIA	2010	2017	2024
Total respondents	1 061	2 590	1 389
Estate with *Ganoderma*	632 (59.6%)	1 279 (49.4%)	751 (54.1%)



SANITATION

(Deboling & chipping)

Life cycle



(Source: http://www.hbp.usm.my/1b/GT/ganoderma.htm)

Saprophyte phase

Pathogenic phase

Fusion of haploids

Root to root contact (2n)

Karyogamy (2n) and meiosis

Basidiospores (n)

Mode of disease transfer

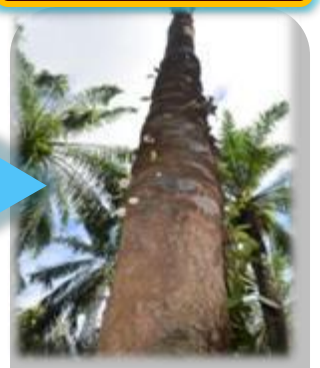
Insect

Wound

BSR disease

USR disease

Infection of oil palm roots



Infection of oil palm trunk at leaf axil?

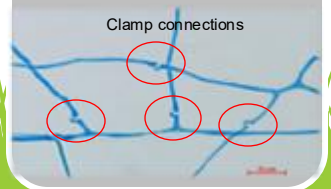
Germination

Hyphal (n)

Hyphal (n)

Compatible mycelia (plasmogamy)

Hyphal (n+n)



Wounded root contact/pathogenesis

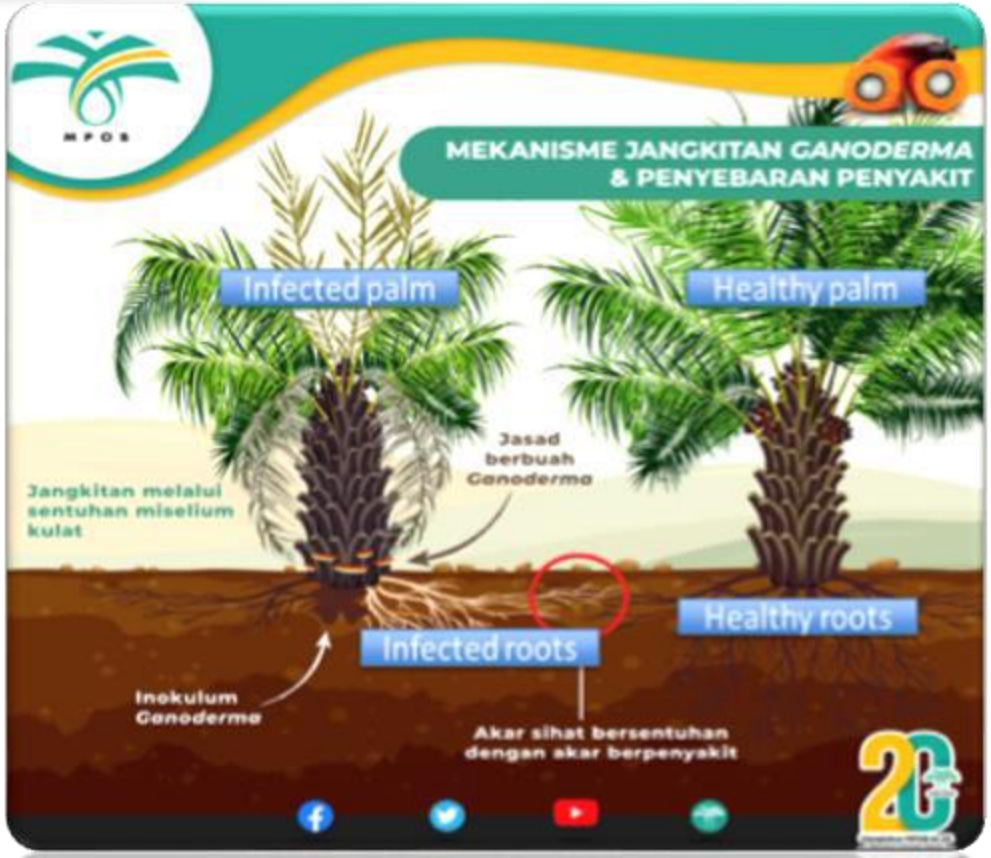
Mechanism of infection

Healthy oil palm roots expands in soil

Infection occurs via *Ganoderma* inoculum surviving on dead and degrading substrate (oil palm biomass)

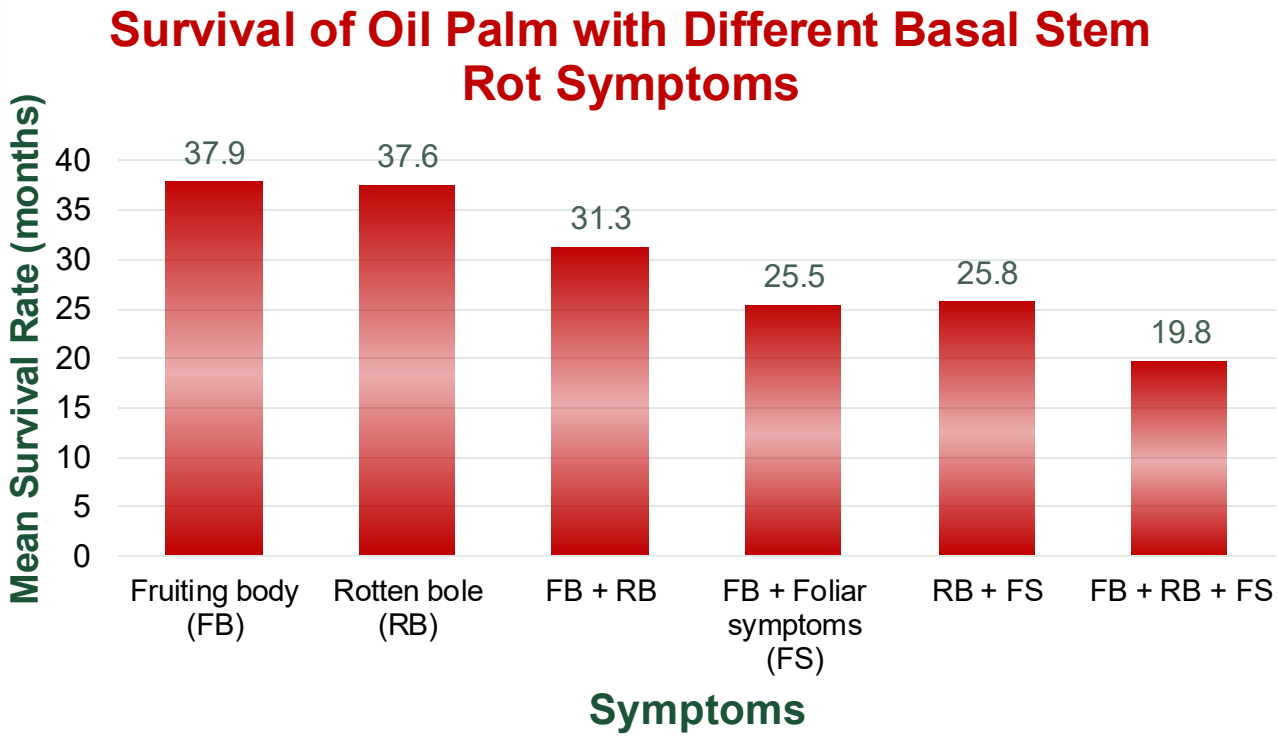
Active mycelia penetrates healthy roots → spreads into cortex and palm bole

Hemibiotrophic → Necrotrophic



Root's basic function affected → reduced water, impaired nutrient absorption → wilting and photosynthesis process disrupted

Progression of Disease



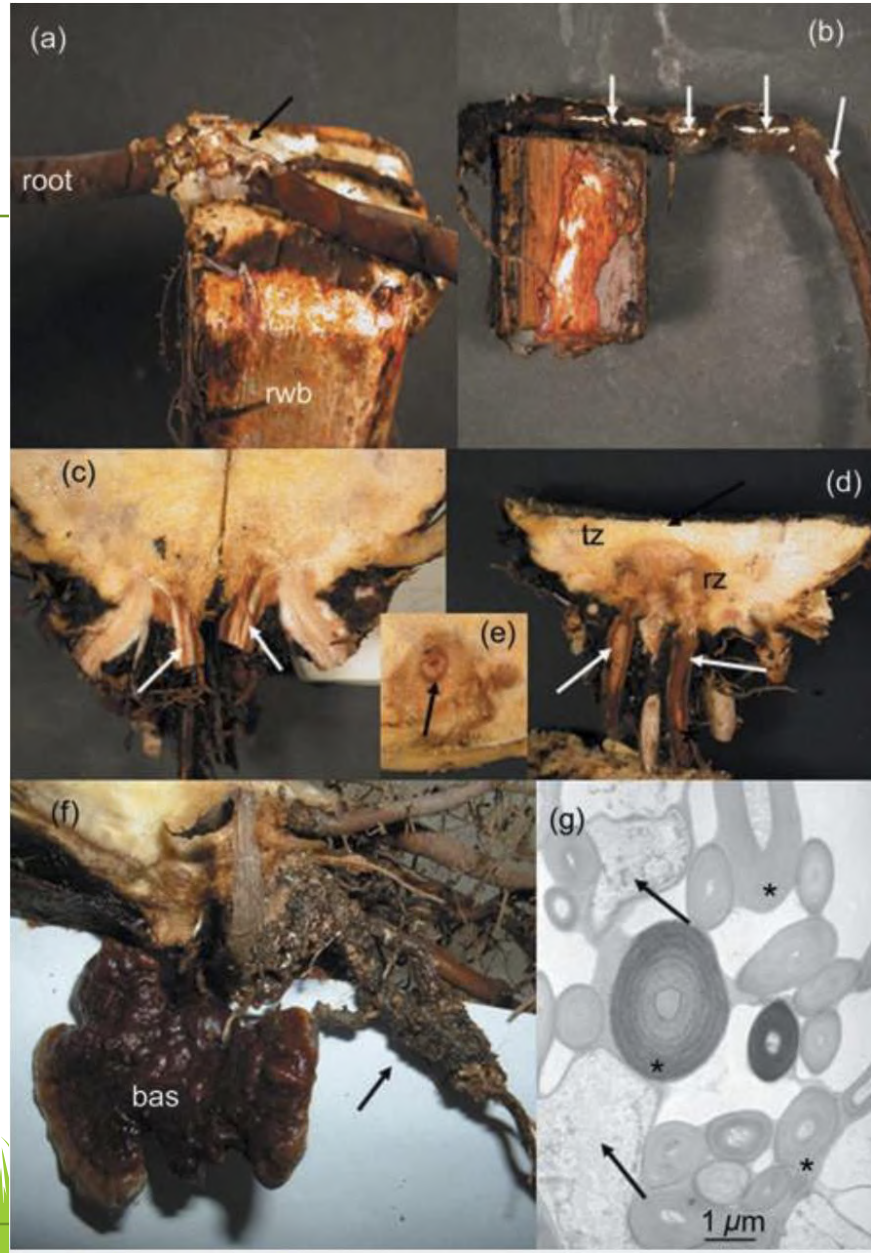
Chen et al., 2017

Spread of *Ganoderma* BSR: Root to root

Root to root contact

- Primary infection occurs through contact of oil palm roots that is healthy with the debris carrying the fungus inoculum
- Secondary infection occurs through root contact between healthy and diseased palms (Idris et al., 2002)
- Fungus gain entry to the host by wounds and dead roots (Singh, 1995)

(Rees *et al*., 2009)



Spread of *Ganoderma* BSR: Basidiospores

Role of basidiospores spread in the field?

Basidiospores are being **produced in millions daily**. **However,** the predicted infection pattern by *Ganoderma* in oil palm plantations do not represent this. **WHY?**

Spread of *Ganoderma* BSR

Basidiospores

- Basidiospores play **a major role in spreading and providing genetic variability** of *G. boninense* (Rees *et al.*, 2009; Cooper *et al.*, 2011)
- Suggesting specific condition is necessary to germinate and initiate infection and mating compatibility
- Papers by Pilotti *et al.,* (2011, 2018 and 2021) have attempted to explain the spread by basidiospores but still couldn’t overrule the role of root to root contact.

Spread of BSR – Insects as Vector

Eumorphus sp. – Handsome fungus beetle

- Insects: capable of facilitating entry of a pathogen into its plant host through the wounds made above ground or below ground of plant structures.
- In a study in Sabah (5 estates) with > 500 basidiocarps were sampled. 8 species of insects detected positive presence of basidiospores
- Handsome fungus beetle, *Eumorphus* spp. had the biggest possibility of transmitting the basidiospores – internally and externally.

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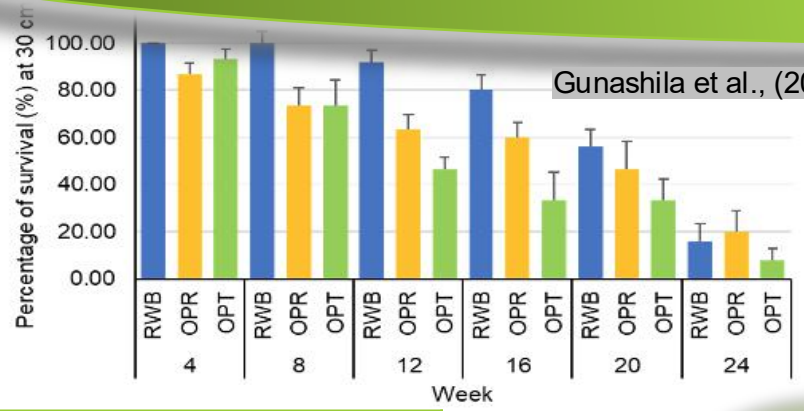
INSECT COMMUNITY ASSOCIATED WITH *Ganoderma* BASIDIOCARPS IN OIL PALM PLANTATIONS OF SABAH

MUHAMMAD NURUL YAQIN SYARIF[1]; SHAMALA SUNDRAM[1]*; SITI NURULHIDAYAH AHMAD[1]; MOHAMED MAZMIRA MOHD MASRI[1] and IDRIS ABU SEMAN[1]

Yaqin et al., (2024)

Predisposing Factors

Predisposing Factors



Gunashila et al., (2022)

Soil Types	BSR Disease Incidence %
Coastal	6.08
Inland	8.72
Peat	14
Lateritic	27.71

Shukri et al., (2020)

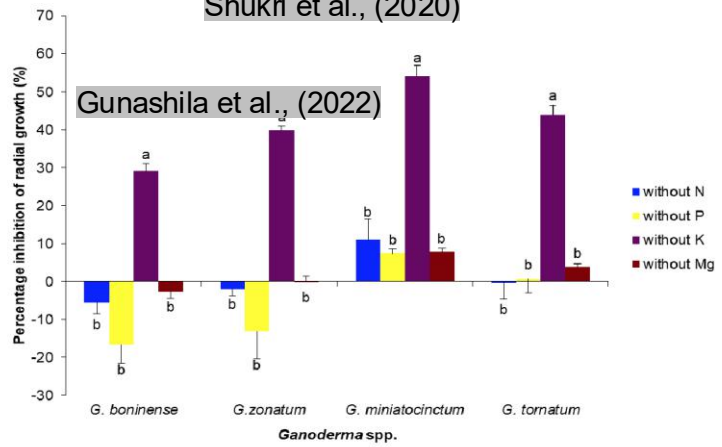
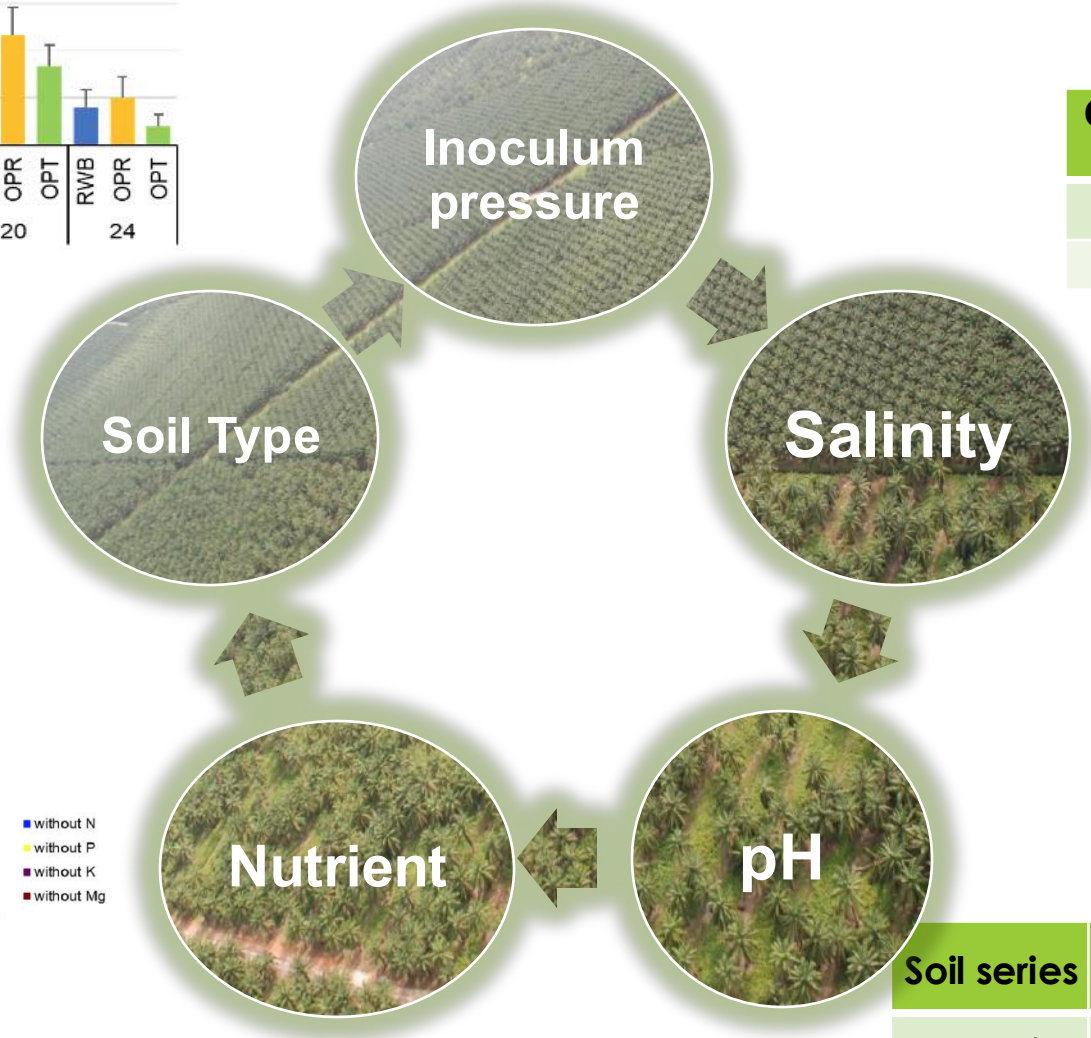


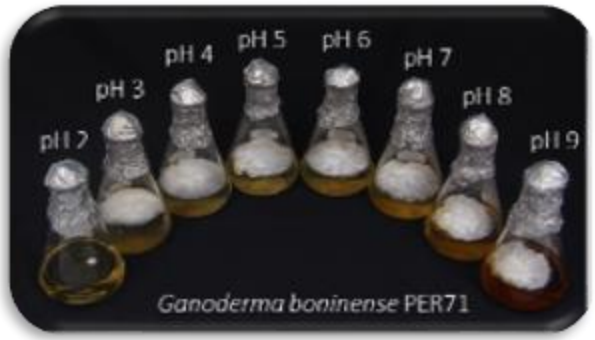
Figure 5: Growth of *Ganoderma* spp. on nutrient manipulated media. Each value represents a mean of five replicates. The legend represents media without each macronutrient respectively (N: Nitrogen; P: Phosphorus; K: Potassium; Mg: Magnesium). Vertical bars indicate standard errors. The different alphabets represent statistically significant variables.



Conductivity at 30 cm (µs/cm)	BSR Incidence (%)
500	44.6
1000	8.4

Gurmit et al., (1991)

Intan et al., (2025)



Soil series	Soil pH	Soil Ca	BSR Incidence (%)
Blenheim	8.13	44	1.3
Bernam	4.66	0.03	10.5

Goh et al., (2020)

Changes throughout the years..

GOOD CULTURAL PRACTICES

Cultural measures involve eradicating and reducing the pathogen inoculums to avoid disease spread

Curative

Standing productive palms

Preventive

Deboling

Chipping

Biocontrol

Replanting

Replanting Technique

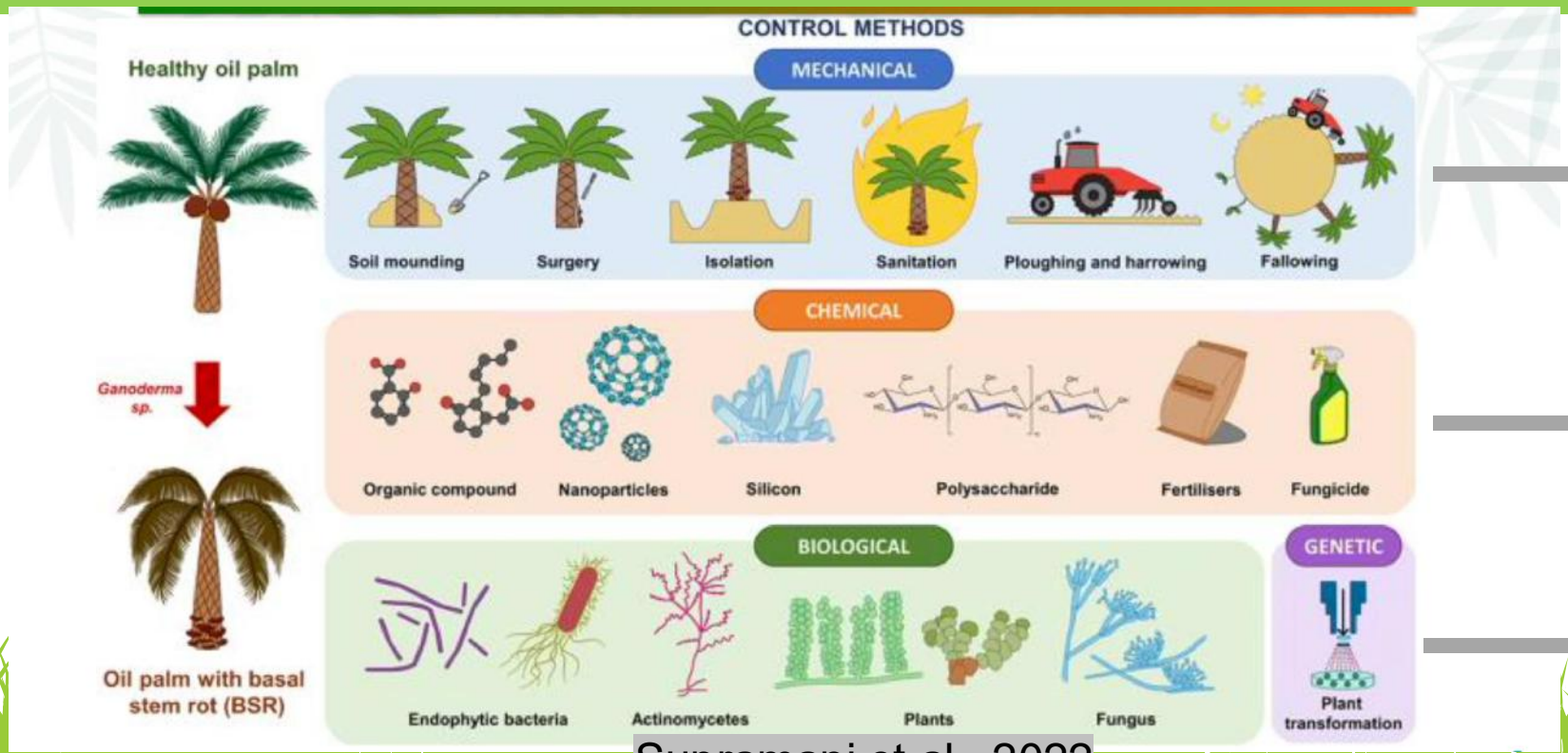
Involves several stages of replanting process. The correct technique in land preparation is regarded a very important decision in managing BSR effectively

Integrated *Ganoderma* Management (IGM)

minimize disease incidence after replanting and existing productive area

delay the onset of *Ganoderma* infection

prolong productive life of palms



Cultural control

Chemical control

Biological control

Supramani et al., 2022

Summary

Sanitation remains as the recommended technique in managing BSR in field

- Timely
- Census – trained staff and conducted annually
- Company policy – replanting and existing productive palms

Integrated *Ganoderma* management (IGM) approach with elements of biological properties such **BCA** is recommended → **soil health**

Predisposing factors specifically PEAT soil type does predispose the oil palm to *Ganoderma* BSR → poor soil condition proving to be a disadvantage

Fundamental research in understanding the **pathogen behaviour** to be prioritized:

- insect vector
- predisposing factors: pH, nutrient, microbial diversity
- Aggressiveness of pathogen

Acknowledgement

- SOPPOA
- Malaysian Palm Oil Board
- Colleagues and staff of Plant Pathology and Biosecurity Unit, MPOB
- Dr Meilina Ong Abdullah (Director of Research)
- Industry Members
  - AAR
  - United Plantation Bhd
  - IOI Plantation
- *Ganoderma* Research Fraternity

First announcement

Organised by: ISOPP MPOB | Co-organised by: CPOPC Codon Genomics

2025 INTERNATIONAL CONFERENCE ON OIL PALM PLANT PROTECTION (ICOPP)

Innovate, Adapt And Strategise

21-22 November 2025

Berjaya Times Square Hotel, Kuala Lumpur

JOIN NOW

Oil palm is an important commodity crop planted along the equatorial belt. As the global population continues to grow, the importance of effective crop protection practices becomes even more pronounced. Embracing innovative and sustainable approaches in crop protection is essential in securing the future of oil palm and adapting to the ever-growing demand for food. It is highly anticipated that this conference will provide the right platform for sharing experiences in research and challenges faced by oil palm growers complementing crop protection and strategies according to their respective countries.

First Announcement

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18 - 20 November 2025
Kuala Lumpur Convention Centre

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Ministry of Plantation and Commodities, Malaysia

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