

DISEASE IDENTIFICATION, DETECTION AND CENSUS OF GANODERMA BASAL STEM ROT

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MALAYSIAN PALM OIL BOARD

Lembaga Minyak Sawit Malaysia

Kementerian Perlindungan dan Komoditi

Why?



Protects plant health

Prevents severe yield & income loss

Early warning

Catching a disease at its early stage allows timely intervention before it spreads widely.

Early control measures are usually cheaper and more effective than trying to manage a widespread outbreak.

Effective disease management

Correctly identifying of disease and disease stages ensures that management strategies (chemical, biological, or cultural) are appropriate.

Misdiagnosis leads to wasted resources and failed treatments.

Stop disease spread

Detection help prevent the introduction and spread of the disease

BSR identification

1

External symptoms

Based on visual
symptoms at
basal of the stem,
foliar and present
of fruiting body



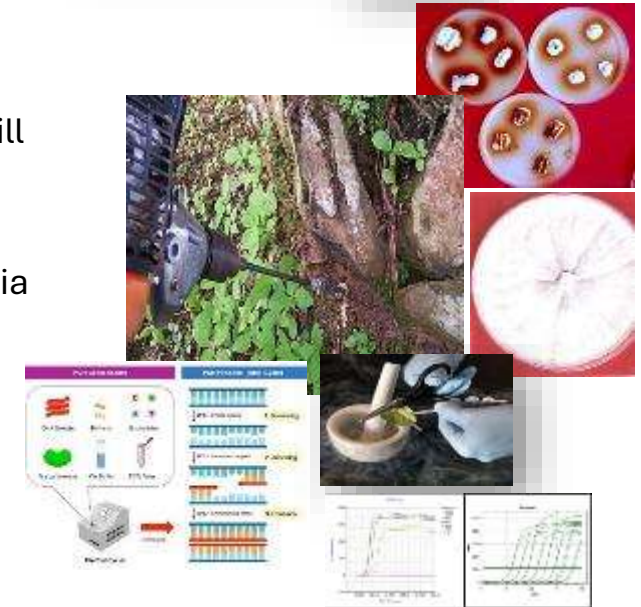
2

Lab-based methods

Involves tissue
sampling using drill

- **Microbiology**
Ganoderma
Selective media
(GSM)

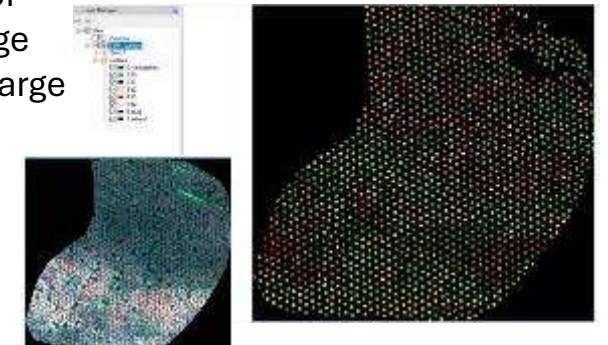
- **Molecular**
PCR & LAMP



3

Aerial-based remote sensing

- Using satellite or
drone/UAV image
- Able to screen large
area



EXTERNAL SYMPTOM(VISUAL)

At basal of the stem and root

Look for:

1. White mycelium, appearing as delicate, thread-like filaments
2. Fruiting bodies
 - White button
 - Bracket shape



*Ganoderma can
be isolate in
laboratory*





**Stem rotting and
decay at the base**



Dead Palm

EXTERNAL SYMPTOMS (VISUAL)

Foliar



Unopen spear and
yellowing fronds



Lower fronds snapped & collapsed



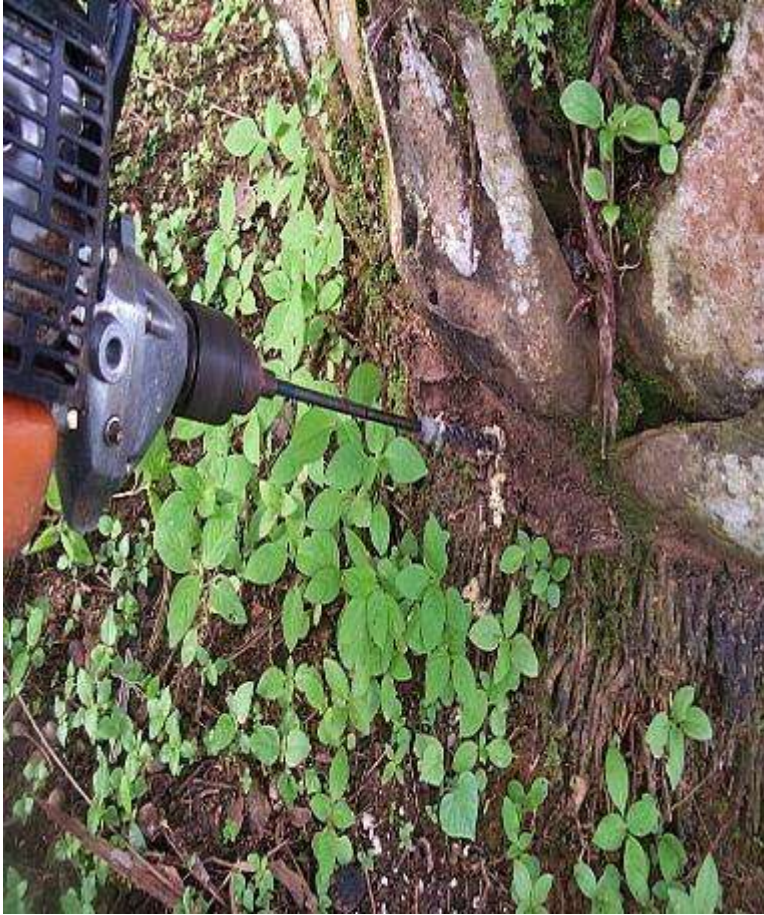
Pelepah tua patah pada petiol dan tergantung ke bawah



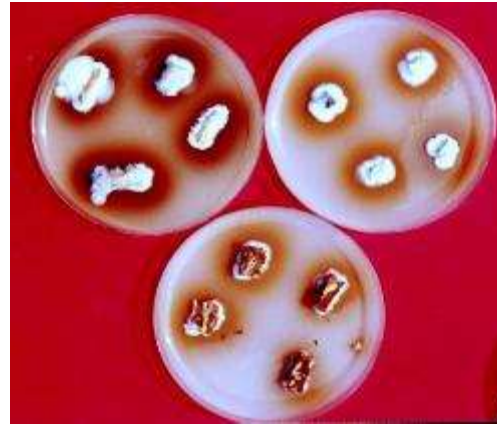
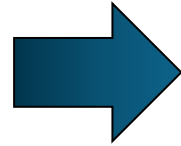
"Skirting"

LAB-BASED METHODS

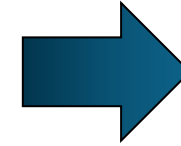
Culture Method



Tissue sampling: Drill at 30 cm in depth using motorized drill (drill bit size; diameter 11 mm, length 45 cm)



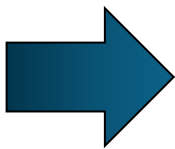
Ganoderma Selective Media (GSM)



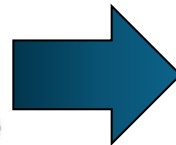
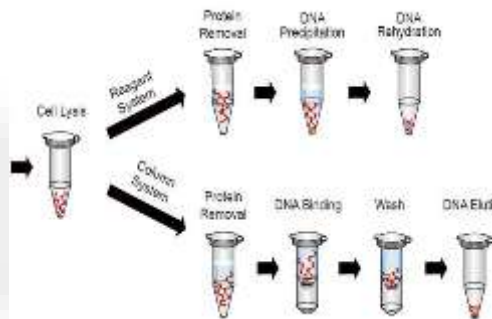
Potato Dextrose Agar (PDA)

LAB-BASED METHODS

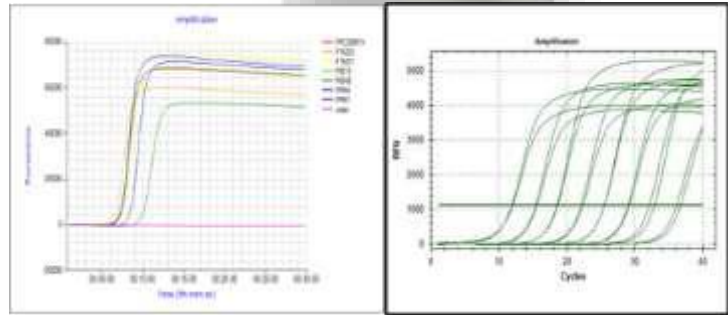
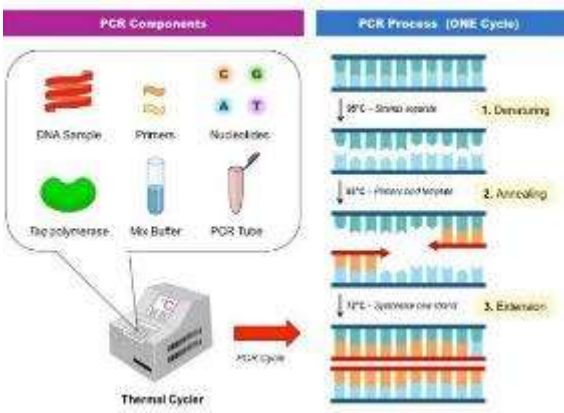
Molecular Diagnostic



DNA EXTRACTION



PCR (polymerase chain reaction)
&
LAMP (Loop-mediated isothermal amplification)



Sample	Detection Limit
Miselium	10 $\mu\text{g}/\mu\text{L}$
Basidiospore	1000 spore
Disease tissue	0.2 ng/g wet weight



AERIAL-BASED REMOTE SENSING



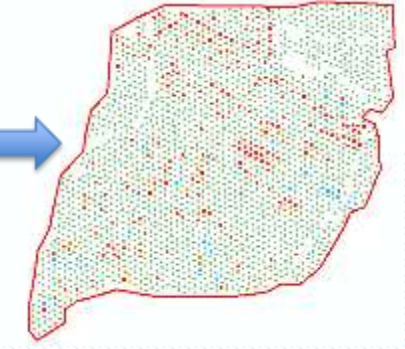
Spectral reflectances value at 662 nm, significant for detection of *Ganoderma* disease



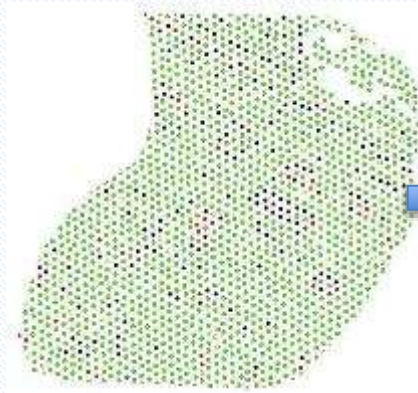
Ground survey



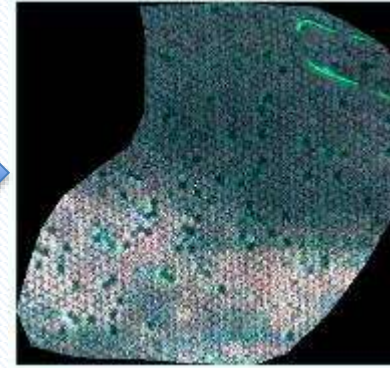
Digitise all the census data into ArcGIS



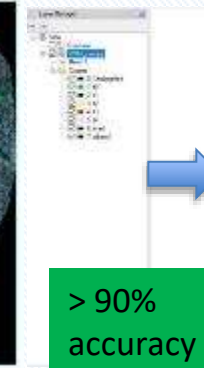
Map of severity *Ganoderma* incidence



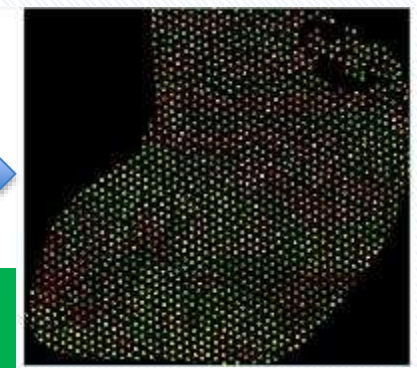
Ground census – GIS data

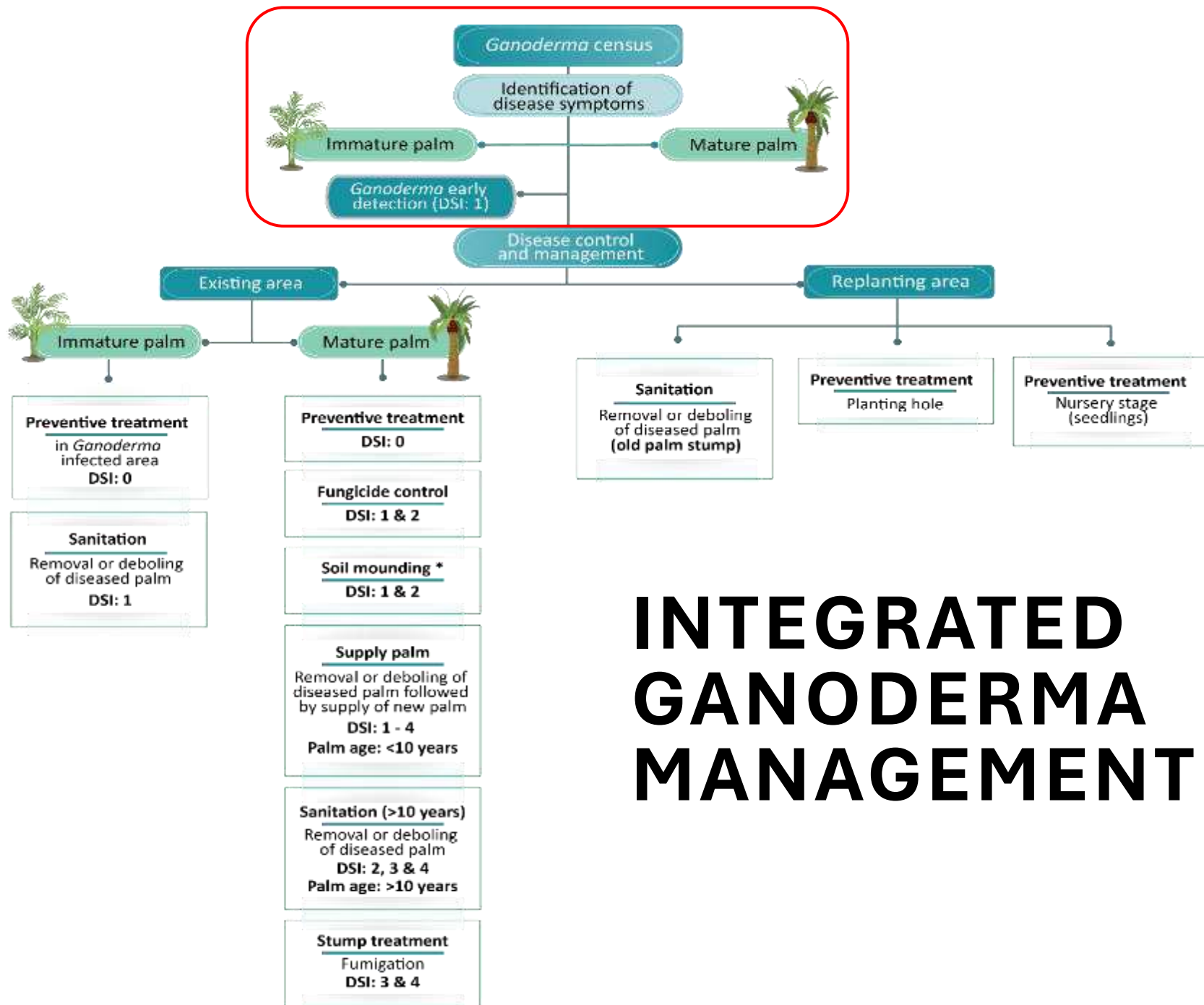


Multispectral image



> 90% accuracy





INTEGRATED GANODERMA MANAGEMENT (IGM)

WHY CENSUS

Understanding disease distribution

Shows where diseases occur, how much they affect, and which areas are hotspots.

Epidemiology & trends

Helps track disease progression over time and identify environmental or management factors that influence outbreaks (if any)

Guides management decisions

Data from a census will help in targeted control (i.e. fungicide or sanitation)

Policy & planning

Provides input for government or industry to allocate resources, develop strategies, and support planners

Evaluating control strategies

Repeated census studies can measure how effective disease management or interventions are over years (generations)



DSI 0

HEALTHY PALM



- 01 No fruiting body, foliar symptom and stem rotting at the base.
- 02 Early detection methods (e.g. GSM or PCR-DNA) showing no (negative) presence of *Ganoderma*.

DSI 1

INFECTED PALM



One-sided yellowing of leaves with the bole/stem at the base progressively rotting

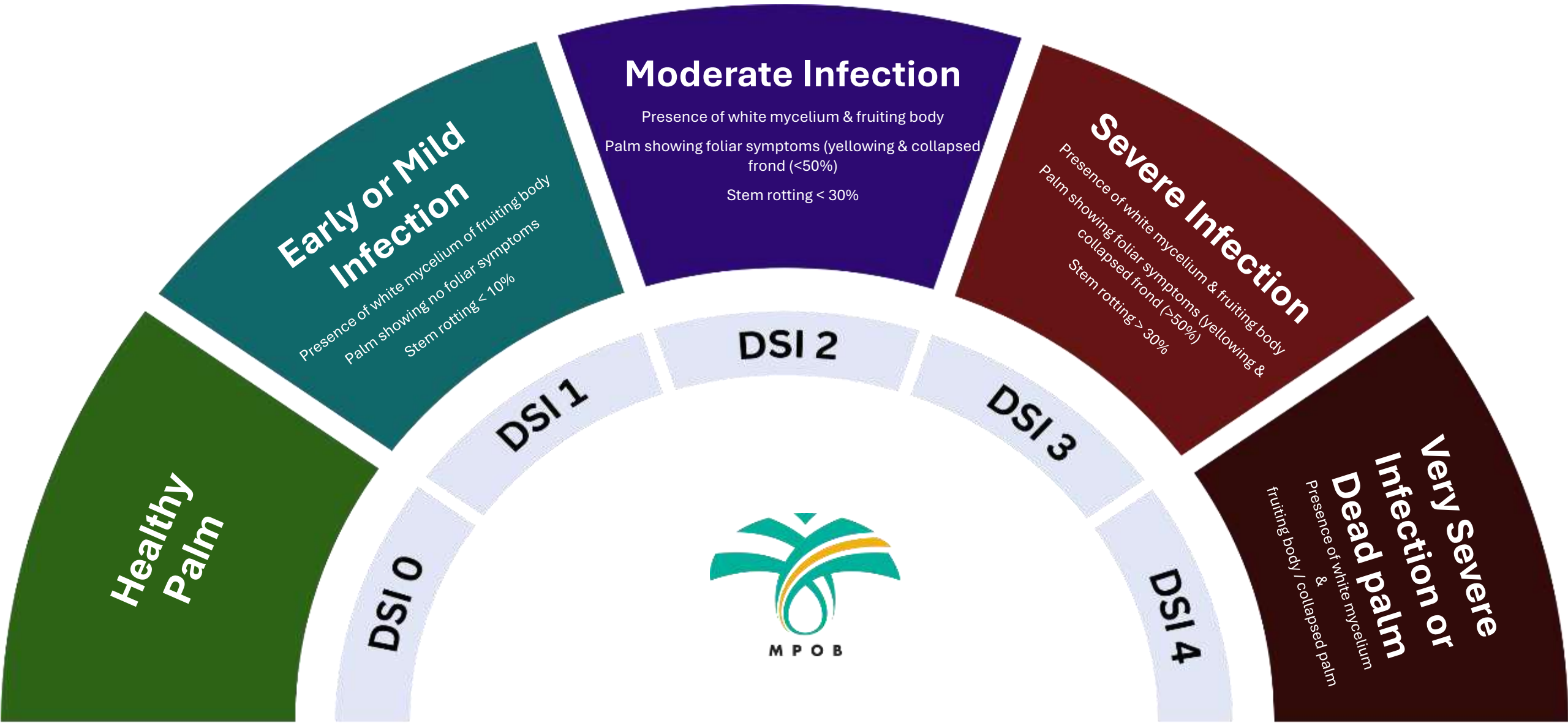


- 01 Mild, moderate and severely infected immature palm.
- 02 In severe infection, palm dies with the bole or stem completely rotted at the base.
- 03 The presence of *Ganoderma* fungus is confirmed using early detection methods (e.g. GSM or PCR-DNA).



DISEASE SEVERITY INDEX

Mature Palms



DSI 1

Early or Mild Infection

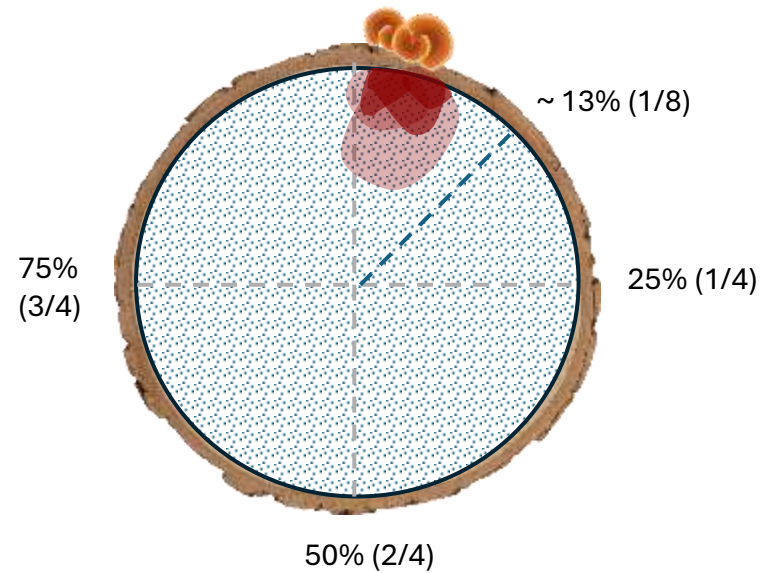
✓ White mycelium
or fruiting body

✓ Stem
rotting

✗ Foliar
symptoms



< 10%



DSI 2

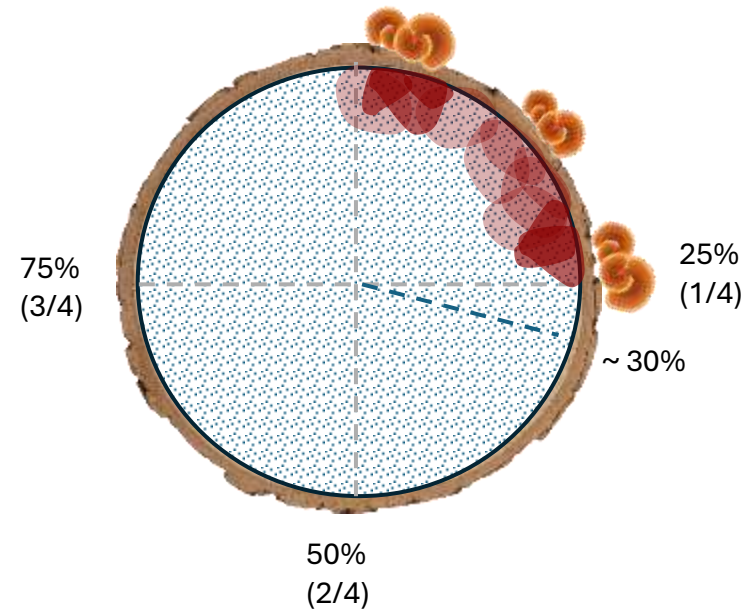
Moderate Infection

✓ White mycelium
or fruiting body



✓ Stem
rotting

< 30% (10% - 30%)



✓ Foliar
symptoms

Yellowing & collapsed
frond (<50%)



DSI 3

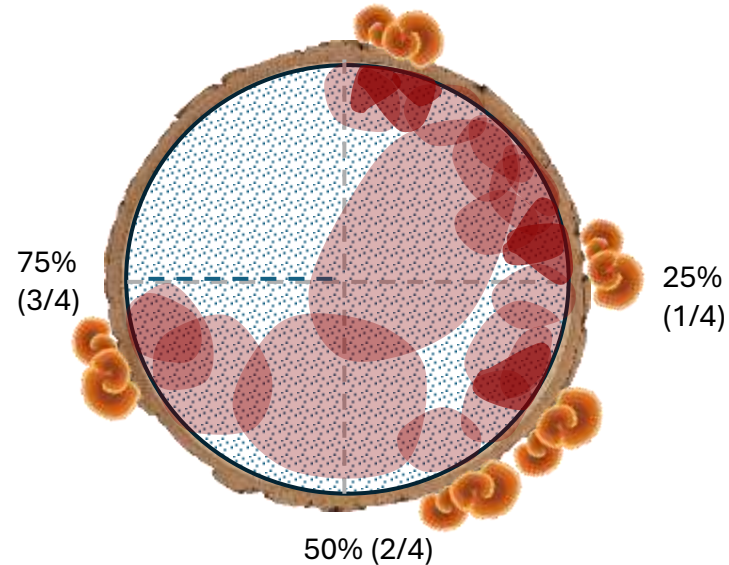
Severe Infection

✓ White mycelium
or fruiting body



✓ Stem
rotting

> 30% (30% - 75%)



✓ Foliar
symptoms

**Yellowing & collapsed
frond (>50%)**



DSI 4

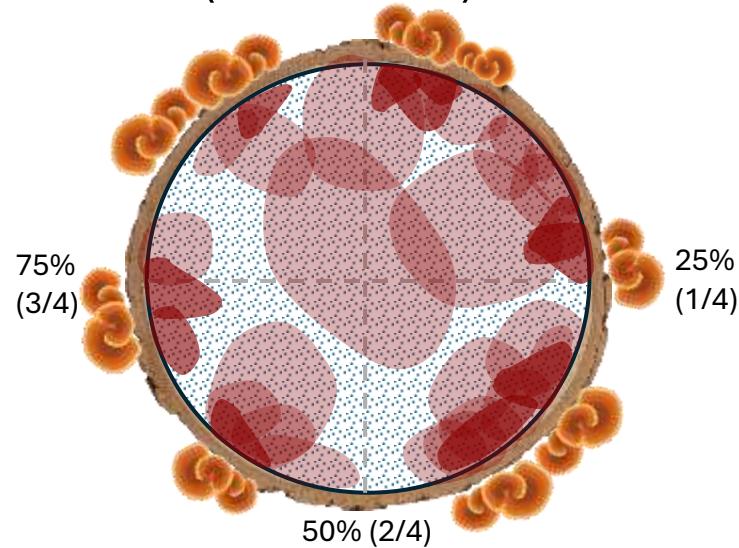
Very Severe Infection or Dead Palm

✓ White mycelium
or fruiting body



✓ Stem
rotting

>75% (75%-100%)



✓ Foliar
symptoms

Collapsed frond (100%)



DSI 1

EARLY INFECTION



DSI 2

MODERATE INFECTION



- 01 Early infection or mild infected palm.
- 02 Presence of white mycelium or fruiting body.
- 03 No foliar symptoms.
- 04 Mild (<10%) or no stem rotting at the base.
- 05 Early detection methods (e.g. GSM or PCR-DNA).

Yellowing of leaves
Snapping of frond (<50%)



- 01 Moderately infected palm.
- 02 Presence of white mycelium or fruiting body (e.g. small white button or bracket shape).
- 03 Palm showing foliar symptoms: yellowing (<50%) and stem rotting (<30%) at the base.
- 04 Confirmed presence of *Ganoderma* fungus using early detection methods (e.g. GSM or PCR-DNA).

2nd EDITION

STANDARD OPERATING PROCEDURES (SOP) GUIDELINES FOR MANAGING *Ganoderma* DISEASE IN OIL PALM

DSI 3

SEVERE INFECTION



Severe foliar symptom (>50%)



DSI 4

DEAD PALM



- 01 Severely infected palm.
- 02 Presence of white mycelium or fruiting body (e.g. small white button or bracket shape).
- 03 Palm showing severe (>30%) stem rotting at the base.
- 04 Confirmed presence of *Ganoderma* fungus using early detection methods (e.g. GSM or PCR-DNA).



- 01 Very severely infected/dead palm.
- 02 Presence of white mycelium or fruiting body (e.g. small white button or bracket shaped form).
- 03 Collapsed/dead palm with severe foliar symptoms and stem rotting at the base.
- 04 Confirmed presence of *Ganoderma* fungus using early detection methods (e.g. GSM or PCR-DNA).



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DSI 1

JANGKITAN AWAL



<10%



- 01/ Pokok sawit yang dijangkiti di peringkat awal atau mengalamijangkitan ringan.
- 02/ Kehadiran miselium putih atau jasad buah (cth. butang putih kecil).
- 03/ Tiada simptom pada daun.
- 04/ Ringan (<10%) atau tiada batang reput pada pangkal.
- 05/ Kaedah pengesanan awal (cth. GSM atau PCR-DNA) menunjukkan pengesanan *Ganoderma* positif.

DSI 3

JANGKITAN TERUK



>30%

Simptom daun yang teruk (>50%)



- 01/ Pokok sawit yang teruk dijangkiti.
- 02/ Kehadiran miselium putih atau jasad buah (cth. butang putih kecil atau bentuk kipas).
- 03/ Pokok sawit menunjukkan simptom daun yang teruk (>50%) dan batang reput (>30%) pada pangkal.
- 04/ Kehadiran kulat *Ganoderma* disahkan melalui kaedah pengesanan awal (cth. GSM atau PCR-DNA).

DSI 2

JANGKITAN SEDERHANA



<30%

Daun menguning
Pelepah patah (<50%)



- 01/ Pokok sawit yang sederhana dijangkiti.
- 02/ Kehadiran miselium putih atau jasad buah (cth. butang putih kecil atau bentuk kipas).
- 03/ Pokok sawit menunjukkan simptom daun: menguning dan pelepah patah (<50%) serta batang reput (<30%) pada pangkal.
- 04/ Kehadiran kulat *Ganoderma* disahkan melalui kaedah pengesanan awal (cth. GSM atau PCR-DNA).

DSI 4

POKOK SAWIT MATI



- 01/ Pokok sawit yang sangat teruk dijangkiti/ mati.
- 02/ Kehadiran miselium putih atau jasad buah (cth. butang putih kecil atau bentuk kipas).
- 03/ Pokok sawit tumbang/ mati dengan simptom daun yang teruk dan batang reput pada pangkal.
- 04/ Kehadiran kulat *Ganoderma* disahkan melalui kaedah pengesanan awal (cth. GSM atau PCR-DNA).



CONCLUSION

Accurate BSR identification and detection is a crucial step towards managing the disease and the backbone of plant disease management

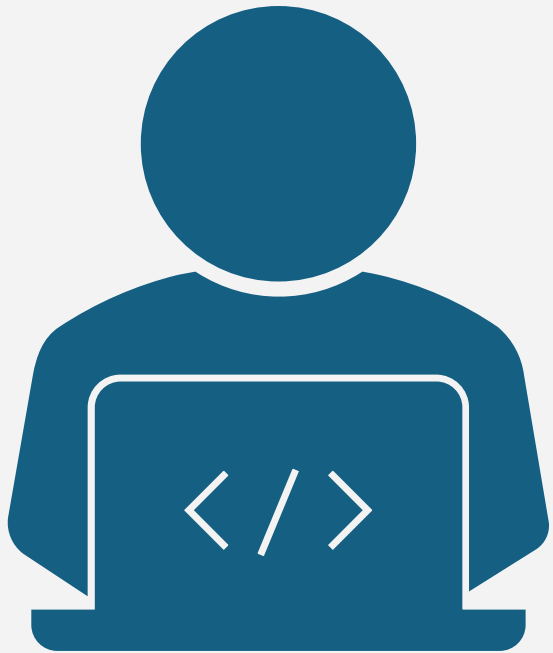
Without it, control measure would be blind, inefficient and waste of resources (time, money & manpower)



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Thank you

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