GANODERMA DISEASE IN OIL PALM AND INTEGRATED CONTROLLING APPROACHES
ECONOMIC LOSSES

Ganoderma had caused a significant economic loss in oil palm producing countries especially Southeast Asia.

According to MPOB (2014):
- In Malaysia, about 4% (60,000 ha) of the total oil palm trees infected with the disease that caused yield losses amounted to RM1.5 billion.
- It was estimated that the total area affected by BSR in 2020 would be around 450,000 ha.
SYMPTOMS OF GANODERMA INFECTED PALM

- Foliar symptoms (yellowing, wilting, dry, unopened spear)
- Presence of *Ganoderma* (*mycelium*, small white button, fruiting bodies)
- Less yield (reduce bunch no and small fruits)
- Stem rotted
- Fell and death palms
CAUSES OF INFECTION

Basal Stem Rot

- **Natural** (inoculums in soil)
- **Root infection** (healthy root contact with infected root or *Ganoderma* inoculums (infected stump))

Upper Stem Rot

The role of **Basidiospores**

- Spores transmit by air & vector (insects)
- MPOB (2003) - 10 out of 13 species of insect were found to carry basidiospores of *Ganoderma* including *Episcapha 4-maculata* as the highest agent.
Ganoderma Management in FELDA

Recommendation
Current Management of BSR

Cultural Method
Mounding >> prolong lifespan for 3-5yrs
Sanitation (2m x 2m x 1.5m)
Plough

Chemical Control
Fungicide (hexaconazole) application (MPOB)

Biological Control
Arbuscular mychorrhizal fungi (AMF)
*Trichoderma* Formulations

Tolerant Planting Materials
Census

✓ Classify the infected palms by Category.

✓ Mark the infected palm using paint or tape.

✓ Record the infected palm in census form and maps.

✓ Marked the infected palm using GPS.
Soil Mounding Application

Oil palm trunk

2 meter width

1 meter

Soil
## Soil Mounding Application

### Summarised data collected over 5 years period of study

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Palm stand</th>
<th>Cost (RM)</th>
<th>FFB Yield (Cumulative)</th>
<th>Profit increase over control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Original palms</td>
<td>Remaining palms</td>
<td>Cost/palm</td>
<td>Overall Cost (RM)</td>
</tr>
<tr>
<td>(T1) SM+AMF</td>
<td>28</td>
<td>10a (35.71%)</td>
<td>19</td>
<td>532</td>
</tr>
<tr>
<td>(T2) SM+Compost</td>
<td>28</td>
<td>7a (25.00%)</td>
<td>20.5</td>
<td>574</td>
</tr>
<tr>
<td>T3 (SM only)</td>
<td>27</td>
<td>13a (48.15%)</td>
<td>13</td>
<td>351</td>
</tr>
<tr>
<td>T4 (Control)</td>
<td>28</td>
<td>3b (10.71%)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Sanitation practice could reduce the rate of *Ganoderma* infection from 43.38% to 0.93% at 10 years after replanted (Idris *et al.*, 2004; Flood *et al.*, 2012)
Ploughing and sanitation

I. Plough is recommended in the area with *Ganoderma* incidence higher than 10%.

II. Planting density up to 148 palms/ha for new generation.
Underplanting technique increase *Ganoderma* incidence (33.7%) as compared to clean clearing technique (14%) and windrowing technique (17.6%) after 15 years of replanting (Khairuddin, 1990).
GPS Mapping FELDA Jengka 13 (Underplanting Technique Vs Normal Planting)

<table>
<thead>
<tr>
<th>Settlers</th>
<th>Standard Planting Practice (% Ganoderma Incidence)</th>
<th>Under-planting Practice (% Ganoderma Incidence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdullah Kemat</td>
<td>1.65</td>
<td>-</td>
</tr>
<tr>
<td>Khaulah</td>
<td>3.30</td>
<td>-</td>
</tr>
<tr>
<td>Moklas Awab</td>
<td>2.21</td>
<td>-</td>
</tr>
<tr>
<td>Nurdin Bahwi</td>
<td>-</td>
<td>5.33</td>
</tr>
<tr>
<td>Othman Ismail</td>
<td>-</td>
<td>3.86</td>
</tr>
<tr>
<td>Mat Stafar Hashim</td>
<td>-</td>
<td>5.51</td>
</tr>
<tr>
<td><strong>Total Ganoderma Incidence</strong></td>
<td><strong>2.39 (12 ha)</strong></td>
<td><strong>4.90 (12 ha)</strong></td>
</tr>
</tbody>
</table>

- Underplanting area 4.90% vs normal planting at 2.39%; reduced 51% disease incidence
- (after 12 years replant)
Palmashield,
A Trichoderma product for Ganoderma Basal Stem Rot Disease in Oil Palm

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Nor Hidayah Bokhari
Beneficial Microbes Centre
Trichoderma sp. as Biocontrol Agent against Ganoderma

- *Trichoderma* sp. are the most studied fungal as Biological Control Agents (BCAs) and biofertilizer.

- Endophytic *Trichoderma* have been studied in the tropical crop such as *Theobroma cacao* (Samuels *et al.*, 2000; Holmes *et al.*, 2004; Bailey *et al.*, 2006; Hanada *et al.*, 2008).
Endophytic *Trichoderma* Product (Biocontrol Agent)

**General Characteristic of *T. asperellum* (M103)**

- Isolated from healthy oil palm roots.
- Antagonistic against *G. boninense* through *in-vitro* study: > 80% PIRG.
- Optimum pH: 3.5 to 4.5
- Optimum temperature: 30°C
- Producing biological active compound that toxic to *G. boninense*.
- Able to produce *cellulase, amylase* and *ligninase* enzymes.
- Able to colonize and sustain in the roots of oil palm.
- Improve soil biodiversity especially at the field.

- Powder formulation form.
- Initial product population achieved $10^{10}$ CFU/gram and gradually decrease to $10^8$ CFU/gram after 12 months storage.
- Moisture content < 30%.
Development of *Trichoderma* product, Nursery Testing

Ganoderma Testing Nursery, Ulu Belitung, Kluang, Johor
Palmashield effectiveness

Oil palm seedlings with and without Palmashield.
Lysis of *Ganoderma* mycelium caused by *Trichoderma* metabolites.
PALMASHIELD EFFECTIVENESS

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Disease Incidence (%)</th>
<th>Disease Severity (%)</th>
<th>Dead Seedling (%)</th>
<th>AUDPC (unit²)</th>
<th>Disease Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palmashield</td>
<td>19.05</td>
<td>20.94</td>
<td>14.29</td>
<td>73.28</td>
<td>51.67</td>
</tr>
<tr>
<td>Control</td>
<td>47.62</td>
<td>40.00</td>
<td>25.4</td>
<td>151.65</td>
<td>0</td>
</tr>
</tbody>
</table>
Mode of Action

- Trichoderma colonise the roots surface and establish an interaction zone.
- Trichoderma releases enzyme response in the plant.
- Deposition of cell wall.

Mycoparasitism by Trichoderma

Trichoderma mycelium outcompetes pathogen growth, and colonizes plant rhizosphere.
### Recommendation

<table>
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<tr>
<th><strong>Stage</strong></th>
<th><strong>Dosage</strong></th>
<th><strong>Application</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Main nursery (3 months seedlings)</td>
<td>50g</td>
<td>During transplanted to main nursery.</td>
</tr>
<tr>
<td>Planting hole</td>
<td>500g</td>
<td>During transplanting to the field.</td>
</tr>
</tbody>
</table>

- **Making a hole for PalmaShield application.**
- **Apply PalmaShield into the hole.**
- **Plant seedling on top of PalmaShield.**
SAVING YOUR FUTURE OIL PALM’s REVENUE

Potential of disease reduction for the next oil palm replanting phase by practicing these Ganoderma control packages:

70-80%

(that will save FELDA/FGV revenue at least RM2B for the next op generation or RM30B for the country)
Thank you