

# **CONTROL AND MANAGEMENT OF *Ganoderma* DISEASE IN PEAT AREAS**

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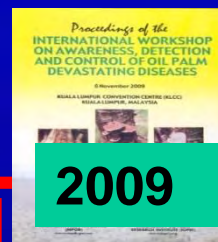
**Presented at the MPOB-SOPPOA Workshop,  
Sibu, Sarawak, 10 Mac 2016**



# INTERNATIONAL SEMINAR ON OIL PALM PESTS AND DISEASES

Jointly organized by MPOB, Malaysia and IOPRI, Indonesia:

1. **2009** - Int. Workshop on Awareness, Detection and Control of oil Palm Devastating Diseases, Kuala Lumpur, Malaysia.
2. **2010** – 2<sup>nd</sup> Int. Seminar on Oil Palm Diseases: Advances in *Ganoderma* Research and Management, Yogyakarta, Indonesia.
3. **2011** – 3<sup>rd</sup> MPOB-IOPRI Int. Seminar: Integrated Pests and Diseases Management, Kuala Lumpur, Malaysia.
4. **2012** – 4<sup>th</sup> IOPRI-MPOB Int. Seminar: Existing and New Emerging Pests and Diseases – Advances in Research and Management, Bandung, Indonesia.
5. **2013** - 5<sup>th</sup> MPOB-IOPRI Int. Seminar: Sustainable Management of Pests and Diseases in Oil Palm - The Way Forward (Insect Pests, Ganoderma & other diseases and Weeds).
6. **Proposed 6<sup>th</sup> IOPRI-MPOB Int. Seminar (Insect pests, Ganoderma & other diseases, Weeds management and Plant Biodiversity); 27-29 September 2016, MEDAN, INDONESIA.**





- Major devastating disease in **South East Asia (SEA)** – Basal stem rot (BSR) or Ganoderma disease – Malaysia and Indonesia



- Other Major devastating diseases (**Africa and America**):

i. Vascular wilt - *Fusarium oxysporum* f.sp. *elaeidis*

ii. Bud rot - *Phytophthora palmivora*

iii. Sudden wilt - *Phytomonas staheli*

iv. Red ring - *Bursaphelenchus cocophilus*

v. Lethal wilt – unknown (Phytoplasma)



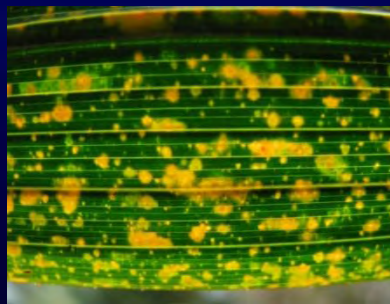
- Other diseases - infecting seeds, nursery seedlings and field palms – are minor – very low incidence and under control.



# FIELD DISEASES

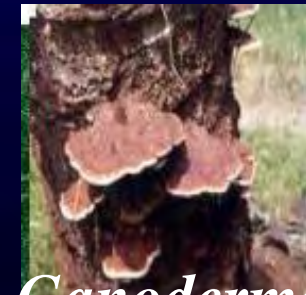
1. 'Crown disease'
2. Pestalotiopsis leaf spot
3. Sooty mould
6. Algae leaf spot
5. Marasmius bunch rot
5. Fruit bunch stalk rot
6. Fruit rot
7. Orange spotting-CCCVd

8. Upper stem rot
9. Stem wet rot
10. Charcoal base rot



(Caused by OS-CCCVd variant)

11. Basal Stem Rot



(Caused by *Ganoderma*)



# Oil Palm Diseases

## 1.2 NURSERY DISEASES

1. Anthracnose
2. Leaf spots disease
3. Corticium leaf spot
4. Nursery root diseases
5. Nursery bud rot
6. Blast disease
7. Pythium root rot

## 1.3 SEED DISEASES

1. Brown germ disease
2. Schizophyllum seed infection



# Penyebab Penyakit: Kulat *Ganoderma* spp.



*G. boninense*



*G. zonatum*



*G. miniatocinctum*

Reput Pangkal Batang

Reput Batang Atas

**Penyakit Ganoderma**





# STATUS OF *Ganoderma* DISEASE IN OIL PALM ESTATES in Malaysia (Idris et al., 2011; PIPOC)

Total no. of estates contacted: 2,355.

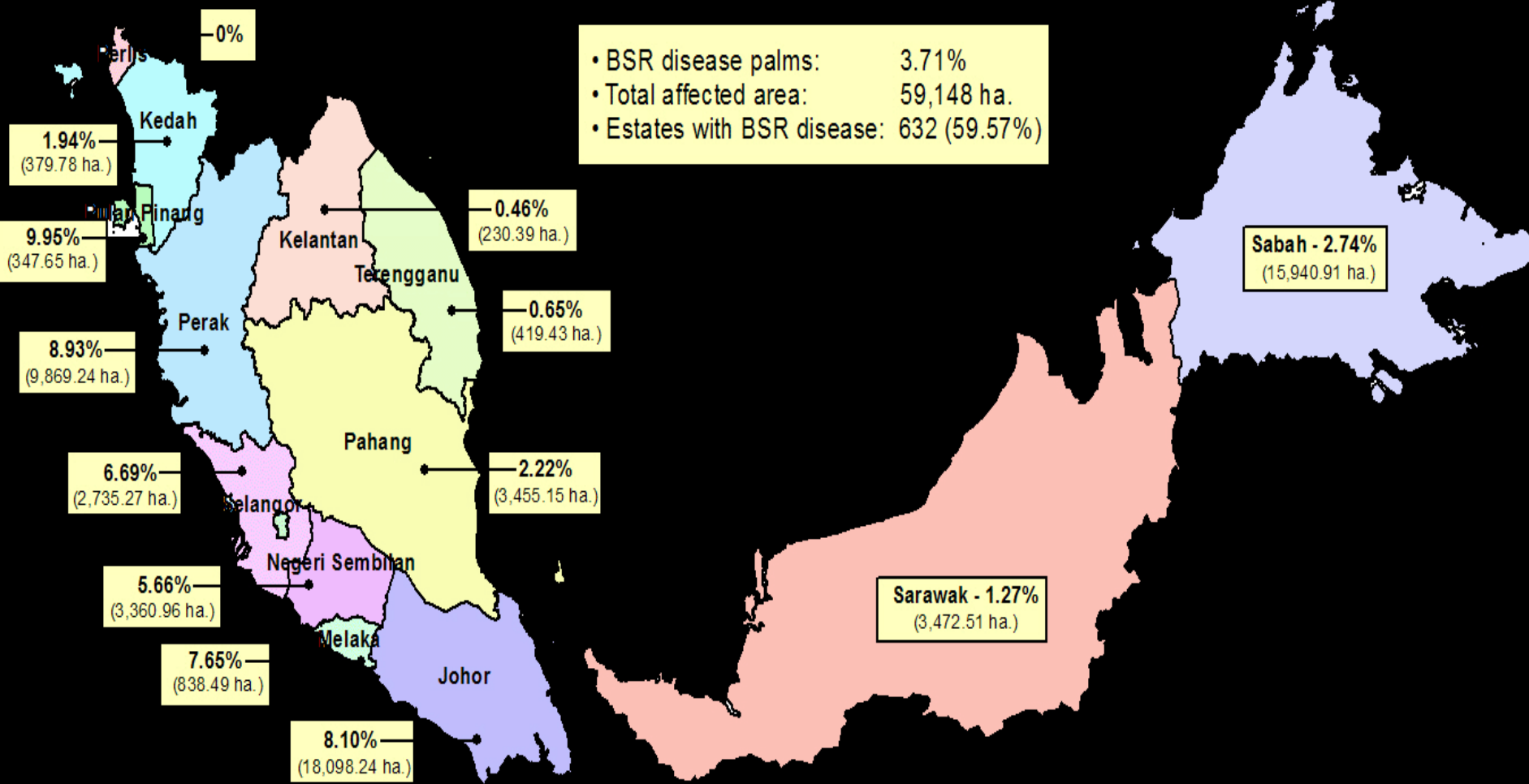
**BSR disease palms: 3.71%**

No. of estates responded: 1061 (45.0%).

**Total affected areas: 59,148 ha.**

Total areas responded: 1.594 million ha.

**Estimated losses : RM 1.5 billion**



# STATUS OF *Ganoderma* DISEASE IN OIL PALM SMALLHOLDERS in Malaysia (Mohd Shukri et al., PIPOC 2015)



Total number of smallholders visited - 9,287.

Total smallholders areas visited - 34,067.9 ha.

Palm age: > 25 years old.



| State        | Number of smallholders with BSR disease |                      |                 |
|--------------|-----------------------------------------|----------------------|-----------------|
|              |                                         | Affected areas (ha.) | BSR disease (%) |
| Johor        | 487                                     | 1,032.9              | 9.7             |
| Kedah        | 0                                       | 0                    | 0               |
| Kelantan     | 0                                       | 0                    | 0               |
| Melaka       | 3                                       | 14.7                 | 7.6             |
| N. Sembilan  | 70                                      | 114.6                | 7.3             |
| P. Pinang    | 11                                      | 40.0                 | 5.8             |
| Pahang       | 24                                      | 35.0                 | 12.2            |
| Perak        | 410                                     | 718.5                | 13.1            |
| Selangor     | 202                                     | 407.1                | 13.9            |
| Terengganu   | 14                                      | 22.0                 | 2.8             |
| Sabah        | 252                                     | 930.8                | 8.0             |
| Sarawak      | 55                                      | 135.0                | 11.2            |
| <b>Total</b> | <b>1,528 (14.8%)</b>                    | <b>3,450.7</b>       | <b>9.2</b>      |



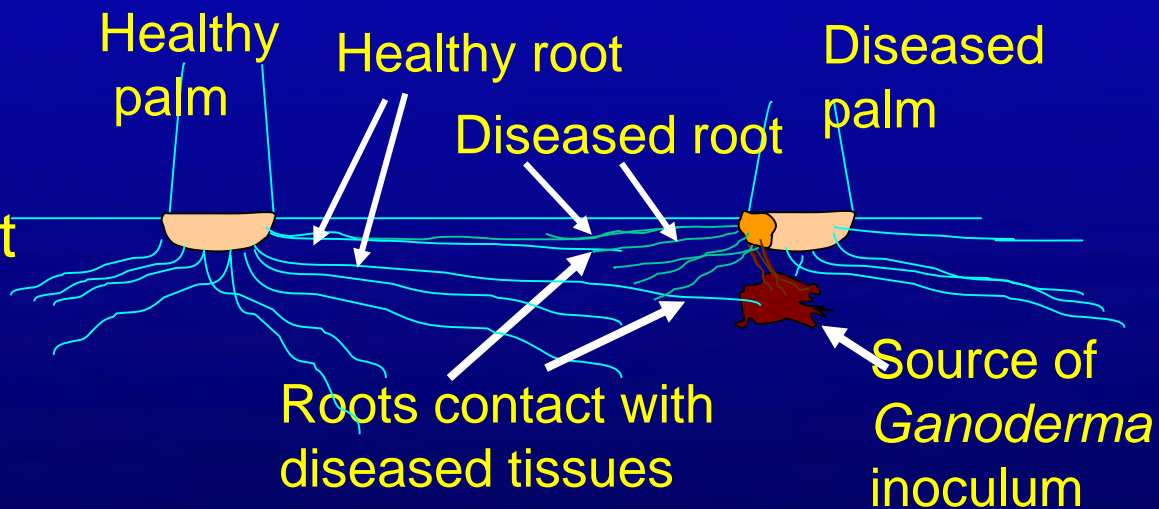


| <b>Division</b>  | <b>Total area of oil palm smallholders (Ha)</b> | <b>Area affected with Ganoderma disease (Ha)</b> | <b>Disease Incidence (%)</b> |
|------------------|-------------------------------------------------|--------------------------------------------------|------------------------------|
| <b>Kuching</b>   | <b>42.44</b>                                    | <b>0</b>                                         | <b>0</b>                     |
| <b>Samarahan</b> | <b>109.09</b>                                   | <b>0</b>                                         | <b>0</b>                     |
| <b>Sri Aman</b>  | <b>186.58</b>                                   | <b>15</b>                                        | <b>8.01</b>                  |
| <b>Betong</b>    | <b>30.6</b>                                     | <b>0</b>                                         | <b>0</b>                     |
| <b>Sarikei</b>   | <b>0</b>                                        | <b>0</b>                                         | <b>0</b>                     |
| <b>Sibu</b>      | <b>20.81</b>                                    | <b>0</b>                                         | <b>0</b>                     |
| <b>Mukah</b>     | <b>0</b>                                        | <b>0</b>                                         | <b>0</b>                     |
| <b>Bintulu</b>   | <b>49.19</b>                                    | <b>0</b>                                         | <b>0</b>                     |
| <b>Miri</b>      | <b>770.15</b>                                   | <b>120</b>                                       | <b>15.58</b>                 |
| <b>Limbang</b>   | <b>0</b>                                        | <b>0</b>                                         | <b>0</b>                     |
| <b>Kapit</b>     | <b>0</b>                                        | <b>0</b>                                         | <b>0</b>                     |
|                  | <b>1,208.86</b>                                 | <b>135.00</b>                                    | <b>16.81</b>                 |



# Epidemiology (disease spread)

1. Mycelium contact - Contact between healthy roots with diseased tissues left buried in soil (Flood et al., 2000; Idris, 2011)



2. Basidiospores – play a role in spreading the disease, through insects vector (Idris, 2011).

*Episcapha 4-maculata* (Tiger beetle) - can carry basidiospores of *Ganoderma* and infect oil palm



# Studies on Planting Density In Relation to *Ganoderma* Disease – Peat soil (Idris et al., 2013)



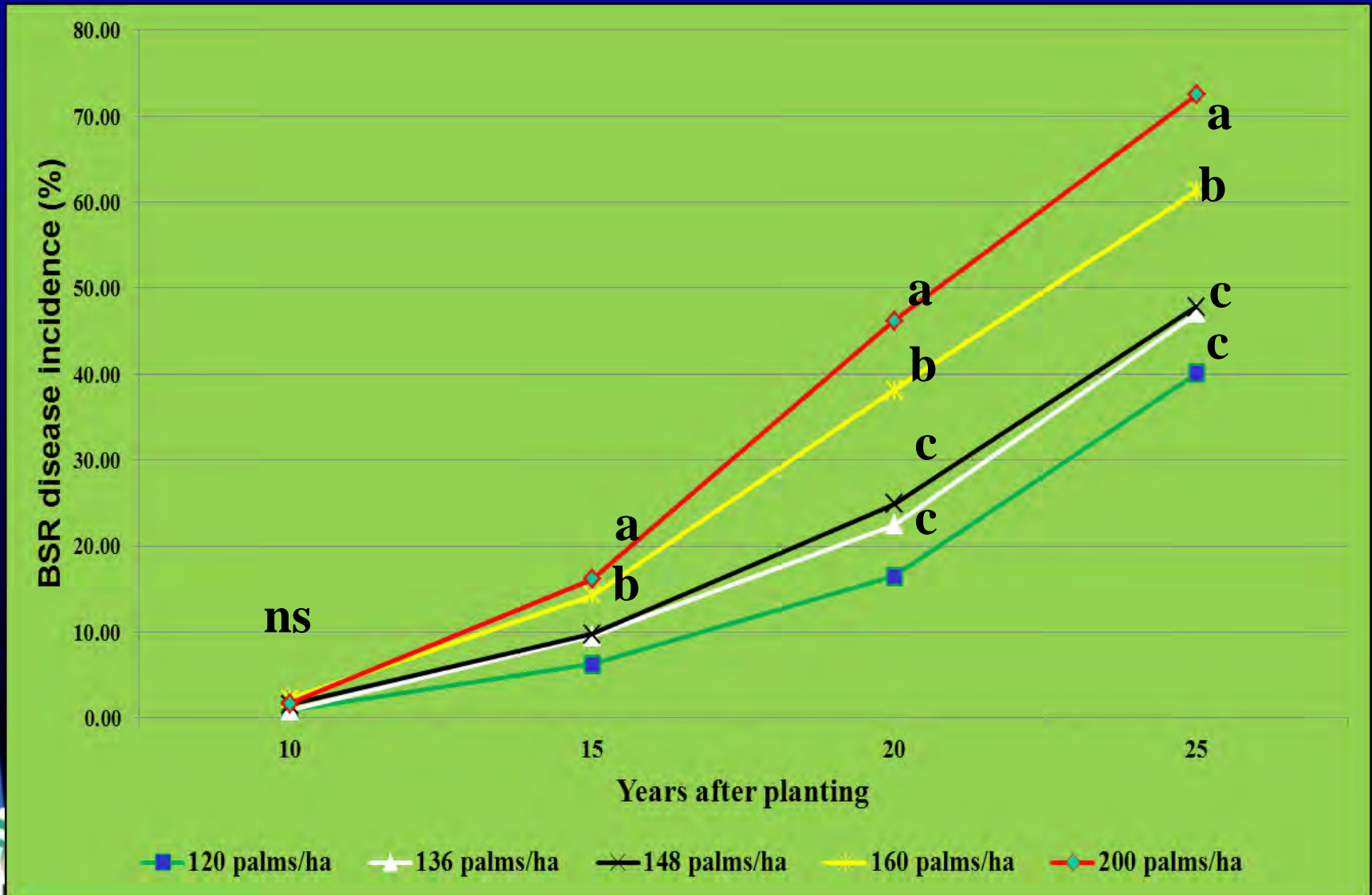
- ✓ Study site: Teluk Intan, Perak
- ✓ Oil palm generation: 1<sup>st</sup>
- ✓ Soil type: Peat soil
- ✓ Previous crop: Ex-jungle
- ✓ Field planted: 1986

## ✓ Planting density (palms/ha):

- i. 120 (Low)
- ii. 136 (Moderate)
- iii. 148 (Moderate)
- iv. 160 (High)
- v. 200 (High)



# Results – BSR disease incidence (%) – 10, 15, 20 and 25 years after planting



# DETECTION AND IDENTIFICATION OF *Ganoderma* DISEASE IN OIL PALM

1. Visual symptoms (external and internal) - foliar symptoms, stem and roots rotting
2. Culture-based : *Ganoderma* Selective Medium (GSM) (Ariffin and Idris, 1991)
3. Polymerase Chain Reaction-DNA-based:
  - 3.1 PCR-DNA primers (Idris et al., 2003)
  - 3.2 Multiplex PCR-DNA Kit (Idris et al., 2010)

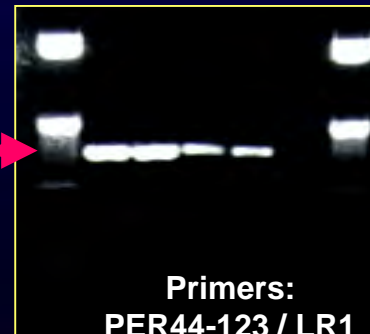


GSM



Pure culture of  
*Ganoderma* on  
PDA

580 bp



# CONTROL AND MANAGEMENT OF *Ganoderma* DISEASE

## Integrated *Ganoderma* Management (IGM) – Strategy 3

*Ganoderma* Genome

Biology and Epidemiology

Early Detection Methods

Resistance Oil Palm Materials

**Sanitation**  
1. Removal of infected palms  
2. At replanting

Biological Control Agents

Beneficial (trace) elements through fertilizer formulation

Chemical control

a) Trichoderma

b) Endophytic Fungi

c) Bacteria

d) Basidiomycetes

e) Actinomycetes

f) Mycorrhizae

1. GanoEF biofertilizer

2. EMBIO™ actinoPLUS

GanoCare™  
i. Organic  
ii. OCSpecial

1. Fungicides  
2. Fumigants

**GUIDELINES FOR THE DEVELOPMENT OF A STANDARD OPERATING PROCEDURES (SOP) FOR MANAGING OF *Ganoderma* DISEASE IN OIL PALM**

1. Existing Planting

2. At Replanting

3. Nursery Seedling



# DISEASE CONTROL AND MANAGEMENT IN EXISTING PLANTINGS

1a. Sanitation by Removal of Diseased Palm (DSI - 1 & 2).

1b. Fumigant Dazomet stump treatment (DSI - 2).

2a. Fungicide (DSI-1).

2b. Soil Mounding (DSI-1)

Nutrient fertilizer - beneficial elements (products) (DSI-0) – **GanoCare™**

Biological Control Agents (products) (DSI-0) – **GanoEF** biofertilizer and **EMBIO actinoPLUS**

Integrated Control



**BSR CENSUS  
Disease Severity Index  
(DSI)**

**DSI - 0 (uninfected)**




**DSI - 1 (Mild/moderate)**

**DSI - 2 (severe / very  
severe / dead)**



# BSR CENSUS

## Disease Severity Index (DSI) - For Mature Palms



| DSI | Description                                                                                                                                                                                                                                                                                                                 | Symptoms                                                                             |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 0   | Uninfected palm (healthy). No fruiting body, foliar symptom and stem rotting at the base. Using early detection methods (e.g. GSM or PCR-DNA) showing no (negative) Ganoderma.                                                                                                                                              |   |
| 1   | Mild / Moderate infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm not showing or showing foliar symptoms (<50%) and slightly stem rotting (10%-30%) at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA). |   |
| 2   | Severe / Very severe (dead) infected palm. Presence of white mycelium or fruiting body (e.g. small white button or bracket shape form). Palm dead/collapsed showing severe foliar symptoms and stem rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA).        |  |





# BSR CENSUS

## Disease Severity Index (DSI) - For Immature Palms

| DSI | Description                                                                                                                                                                                                                                                                                                                  | Symptoms                                                                             |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 0   | Uninfected immature palm (healthy). No fruiting body, foliar symptom and stem rotting at the base. Using early detection methods (e.g. GSM or PCR-DNA) showing no (negative) Ganoderma.                                                                                                                                      |   |
| 1   | Moderate/Mild and severe/very severe infected immature palm. One sided yellowing leaves with the bole or stem slightly rotting at the base. In severe infection, palm dead with the bole or stem completely rotting at the base. Confirmed presence of Ganoderma fungus using early detection methods (e.g. GSM or PCR-DNA). |  |



# 1. Sanitation by removal (deboling) of infected palm (Idris et al; 2004)

**A. BSR census (DSI 1 & 2)**

**B. Pushing infected palm – backhoe or excavator**

**C. Excavating stump and root masses (1.5 - 2m length X 1.5 - 2m width X 1.0 - 1.5m depth)**

**D. Refilling with nearby soil**

**E. Chipping trunk, stump and root masses (<10 cm thickness)**

**F. Resupply palm, if the existing stand < 10 years old.**



**Adoption:**

**289 estates - 9,101.0 ha.**



## 2. Fumigant dazomet – stump treatment for eradicating of *Ganoderma* inoculum (Idris and Maizatul, 2012)

- ✓ Field study - *Ganoderma* inoculum significantly reduced when infected stumps treated with dazomet.
- ✓ Dazomet moved into the stump and caused death to the *Ganoderma* fungus, therefore reducing the spread of *Ganoderma* disease within the oil palm plantation.
  - A. BSR census (DSI 2)
  - B. Stump/trunk cut down using chainsaw
  - C. Apply dazomet (basamid) at **500 g/stump**
  - D. Spraying water with 250 ml
  - E. Cover with polyethene bag or with soil



### 3. Fungicides – Infected standing palms WITH NO FOLIAR SYMPTOMS (productive) – Curative treatment / prolonging life of infected palm

#### Two fungicides:

- i. Hexaconazole, e.g. anvil<sup>R</sup>
- ii. Tetraconazole, e.g. galileo<sup>R</sup>

- **Hexaconazole** – Completed 3 field trials:
  - i. Segamat, Johor (Inland soil), ii. Sepang, Selangor (coastal soil); and iii. Teluk Intan, Perak (Peat soil).
- Diseased palms treated with hexaconazole (**4.5 g a.i + 7 L water**) using hand-knock injector significantly lower dead palms compared to untreated.
- **An average 74.4%** (3 trials: 66.6% – 83.3%) of infected palms treated with hexaconazole still alive and producing fruit bunches and none from untreated palms.



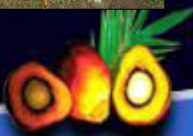
# Trunk injection with fungicide hexaconazole on *Ganoderma*-infected palm

- A. BSR census (DSI 1)
- B. Remove the old frond butt using chisel or chainsaw
- C. Drilling 2 holes into the trunk/stem at the base using motorized drill engine attached with drill bit
- D. Prepare fungicide solution
- E. Injecting fungicide solution into drilling hole with a total of 6 L (3 L/hole) using injector attached with motorized knapsack sprayer
- F. Spraying 1 L fungicide solution onto the stem/trunk at the base



**Adoption:**

**228 estates - 2,150.0 ha.**



# CONTROL AND MANAGEMENT OF *GANODERMA* AT REPLANTING

Replanting –  
before and  
during

Sanitation by  
excavating old palm  
stands and ploughing

Biological Control  
Agents

Nutrient fertilizer -  
beneficial elements

Integrated Control

Nursery -  
Seedling

Biological Control  
Agents

Nutrient fertilizer -  
Beneficial elements



# CONTROL AND MANAGEMENT OF *GANODERMA* AT REPLANTING

## 1. Do Not Under-planting - high BSR incidence in replanted palms



**BSR disease in replanted palms after adopting underplanting oil palm with oil palm, 16-18 years after planting (2<sup>nd</sup> generation) (Idris, 2012)**



| Plantation group                | BSR disease (%) |
|---------------------------------|-----------------|
| Estate 1-Batu Pahat (36.8 ha)   | 47.5            |
| Estate 2-Kluang (45.6 ha)       | 42.0            |
| Estate 3-Segamat (29 ha)        | 33.4            |
| Estate 4-Sepang (39.2 ha)       | 57.5            |
| Estate 5-Kuala Selangor (23 ha) | 32.8            |
| Estate 6-Teluk Intan (32 ha)    | 31.8            |
| Estate 7-Sg. Krian (18.5 ha)    | 49.3            |
| Estate 8-Seberang Prai (27 ha)  | 31.7            |



## 2. Underplanting Oil Palm with Coconut – high BSR incidence in oil palms



**BSR disease in oil palms after adopting underplanting oil palm with coconut, 13-18 years after planting (1<sup>st</sup> generation of oil palm) (Idris, 2012)**



| Smallholders                    | BSR disease (%) |
|---------------------------------|-----------------|
| Kebun 1-Batu Pahat (5.6 ha)     | 47.5            |
| Kebun 2-Pontian (10.5 ha)       | 35.2            |
| Kebun 3-Banting (8.0 ha)        | 31.8            |
| Kebun 4-Sepang (4.5 ha)         | 32.6            |
| Kebun 5-Kuala Selangor (3.5 ha) | 52.1            |
| Kebun 6-Teluk Intan (6.0 ha)    | 56.0            |
| Kebun 7-Sg. Krian (12.5 ha)     | 44.8            |
| Kebun 8-Bagan Datoh (4.7 ha)    | 34.2            |





# Strategies To Control *Ganoderma* Disease At Replanting:

## 1. Sanitation by:

i. excavating (deboling) of boles, stumps and root masses of all old palms;

ii. ploughing along the new planting row; and

iii. planting new palm along the ploughing areas



**2. Preventive treatments**, e.g. biological products, organic fertilizer ect



# Effects of sanitation in the old stand on BSR incidence in the replanted palms (Idris, 2012).

## Two Study Sites:

Site 1: Sepang, Selangor

Soil type : Selangor series (coastal)

Study started : 1992

BSR incidence (1<sup>st</sup> generation): T1 (39.9%) and T2 (43.4%)

Planting density (1<sup>st</sup> generation): 136 palms/ha (2<sup>nd</sup> generation): 148 palms/ha

Site 2: Segamat, Johor

Soil type : Durian series (Inland)

Study started : 1993

BSR incidence (1<sup>st</sup> generation): T1 (35.4%) and T2 (36.8%)

Planting density (1<sup>st</sup> generation): 148 palms/ha (2<sup>nd</sup> generation): 160 palms/ha

## Mean incidence of BSR disease on replanted palms, 15 years after planting.

| Treatment                                                                                                                            | BSR incidence on replanted palms (%) |                |             |
|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------|-------------|
|                                                                                                                                      | Sepang, Selangor                     | Segamat, Johor | Average (%) |
| T1 - without sanitation (estate practices including pushing the old stands, shredding, stacking and single burning)                  | 29.0                                 | 49.8           | 39.4        |
| T2 - sanitation (estate practices + excavating soil, stumps and root masses; ploughing and planting new palms along ploughing areas) | 6.5                                  | 10.6           | 8.5         |
| Disease control (%)                                                                                                                  | 22.5                                 | 39.2           | 30.8        |

**Adoption:**

**290 estates - 51,660 ha.**



# Ganoderma Incidence in Replanted Areas in Sime Darby Plantations (Teh et al., 2010)

| Field No. | Ha     | Total sph infected by <i>Ganoderma</i> (2006) |          |
|-----------|--------|-----------------------------------------------|----------|
| 92BD      | 254.80 | 14                                            | 18 (13%) |
| 94BD      | 608.59 | 12                                            | 20 (15%) |
| 95BD      | 228.88 | 11                                            | 10 (7%)  |
| 95BD1     | 385.80 | 11                                            | 14 (10%) |
| 92M       | 184.94 | 14                                            | 6 (5%)   |
| 94M       | 506.21 | 12                                            | 2 (1%)   |
| 95M       | 222.71 | 11                                            | 1 (1%)   |
| 95M1      | 101.27 | 11                                            | 2 (1%)   |
| 95M2      | 239.63 | 11                                            | 1 (1%)   |

Not ploughed

Ploughed Before Planting



# Monitoring Effects of Sanitation at replanting on Ganoderma Disease in replanted palms by Oil Palm Plantations

**BSR disease incidence,  
3 years after planting:**

1. Estate 1 (75 ha, Johor) – 5%.
2. Estate 2 (84 ha, Perak) – 3%.
3. Estate 3 (160 ha, Selangor) – 3.5%.
4. Estate 4 (65 ha, Johor) – 2.8%.
5. Estate 5 (36 ha, Perak) – 2.5%.
6. Estate 6 (73 ha, Johor) – 1.5%.
7. Estate 7 (62 ha, Selangor) – 3.2%.

**BSR disease: 1.5 – 5%.**



# PREVENTIVE TREATMENT (LONG TERM CONTROL STRATEGIES)

## Commercial Products:

- 1. GanoEF biofertilizer**  
(*Hendersonia GanoEF1*)  
(Idris et al., 2012)
- 2. EMBIO™ actinoPLUS**  
(*Streptomyces GanoSA1*)  
(Idris et al., 2013)
- 3. GanoCare™ (organic and OCSpecial fertilizer)**  
(Idris et al., 2014; 2015)

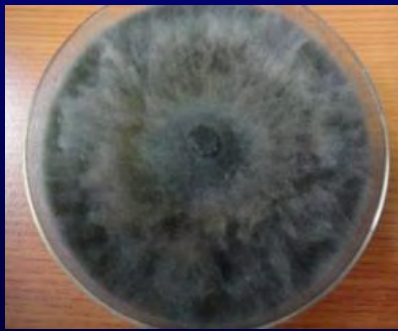


# 1. GanoEF Biofertilizer (Commercial product) (Biological Control agents)

Jointly developed:

**All Cosmos Industries Sdn. Bhd.,  
Pasir Gudang, Johor, Malaysia**

**Website: [www.allcosmos.com](http://www.allcosmos.com)**



✓ Incorporated *Hendersonia*  
GanoEF1 (endophytic fungus) into  
organic materials as carriers.

**Idris et al., 2012;  
Nurshyeda et al., 2015**

**Product launching on  
14<sup>th</sup> June 2012,  
MPOB, Malaysia**



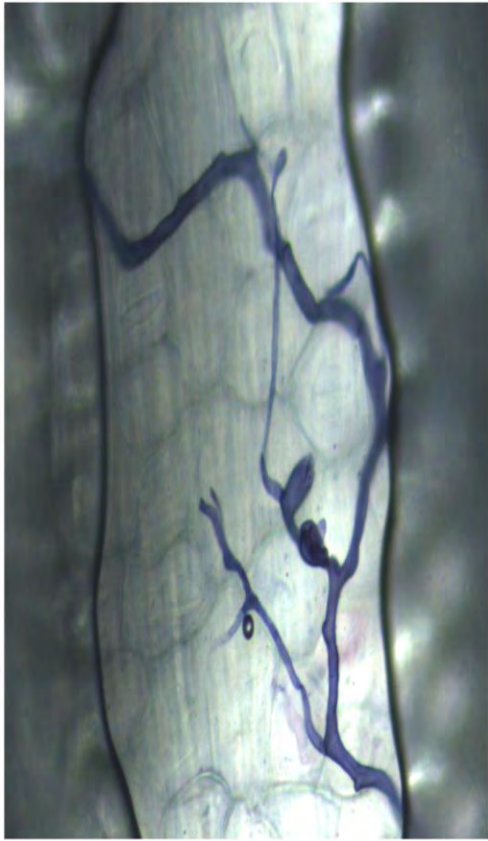
**2012 – ITEX 2012**

- 1. Gold Medal Award**
- 2. Malaysia Innovative Product Award**

**2014 – MyIPO Anugerah  
Harta Intektual**



# Endophytic fungus: *Hendersonia GanoEF1*



## Oil palm roots:

Colonization in mainly in the primary and secondary roots and other roots of oil palm -

- Immature palms: 64 - 88%.
- Young palms: 51 - 76%.
- Mature palms: 42 - 65%.

**Oil palm roots increased the levels of active compound / enzyme activities: lignin and chitinase, glucanase, peroxidase (PO) and phenylalanine ammonia lyase (PAL) - which are known to be physical barrier to *Ganoderma* infection.**

Nurshyeda et al., 2012.  
Nurshyeda, 2015



## 2. Nursery testing – effects of GanoEF biofertilizer in controlling *Ganoderma* disease in oil palm seedlings (Nurshyeda et al., 2015)

- Two treatments were evaluated with 30 seedlings per treatment. Seedling treated with GanoEF biofertilizer applied in nursery (4X, 50 g/seedling). Seedling was inoculated with *G. boninense* using rubber wood block (RWB) sitting technique.
- After 8 months of inoculation, seedlings treated with GanoEF biofertilizer significantly lower disease incidence and died due to *Ganoderma* infection. BSR disease was reduced 69.5% in seedlings treated with GanoEF biofertilizer .

| Treatment                                                                           | Disease incidence (%) | Died seedlings (%) | Disease reduction (%) |
|-------------------------------------------------------------------------------------|-----------------------|--------------------|-----------------------|
| Untreated seedlings and inoculated with <i>G. boninense</i> (control)               | 93.3 a                | 83.8 a             | 69.5                  |
| Seedlings treated with GanoEF biofertilizer and inoculated with <i>G. boninense</i> | 46.7 b                | 48.4 b             |                       |



### 3. Field testing – effects of GanoEF biofertilizer in controlling *Ganoderma* disease in field planted oil palm (Nurshyeda et al., 2015)

- Two treatments were evaluated with 60 seedlings per treatment. Seedling treated with GanoEF biofertilizer applied in nursery (3X, 50 g/seedling); planting hole (1X, 500 g/palm; and after planting (2 kg/palm/year).
- Twelve-month old seedlings were planted 35-45 cm away from *Ganoderma*-infected stump (using seedling baiting technique) .
- After 36 months of planting, 4.9% palms treated with GanoEF biofertilizer showing symptoms of BSR disease and died due to *Ganoderma* infection compared to the untreated seedlings (83.3%). Palm died was confirmed due to *Ganoderma* disease by placing the roots or stem tissues onto the *Ganoderma* selective medium (GSM).

| Treatment                                   | Died palms due to <i>Ganoderma</i> infection (%) |
|---------------------------------------------|--------------------------------------------------|
| Untreated seedlings (control)               | 83.3                                             |
| Seedlings treated with GanoEF biofertilizer | 4.9                                              |



**Palm treated with GanoEF biofertilizer**



**Palm untreated with GanoEF biofertilizer (died due to *Ganoderma* infection)**



## 2. EMBIO™ actinoPLUS (Commercial product) (Biological control agents)

Jointly developed:

Pascal Biotech Sdn. Bhd.,  
Shah Alam, Selangor,  
Malaysia

Email: [info@pascal-biotech.com](mailto:info@pascal-biotech.com)

Website: [www.pascal-biotech.com](http://www.pascal-biotech.com)



The product contains *Streptomyces* GanoSA1 (soil actinomycete), vermiculite and biochar.

2013– MPOB Anugerah Inovasi Terbaik

2014 – ITEX 2014

1. Gold Medal Award
2. Best Malaysia Innovative Product Award



## 2. Nursery testing – effects of EMBIO™ actinoPLUS in controlling *Ganoderma* disease in oil palm seedlings (Shariffah et al., 2015)

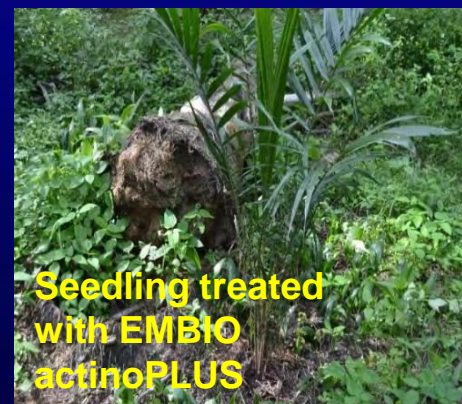
- Two treatments were evaluated with 30 seedlings per treatment.
- Seedling treated with EMBIO actinoPLUS applied 4 times (at 3, 4, 7 and 10 month old, 50 g/seedling). Seedling was inoculated with *G. boninense* using rubber wood block (RWB) sitting technique.
- After 8 months of inoculation, seedlings treated with EMBIO actinoPLUS significantly lower disease incidence and died due to *Ganoderma* infection. BSR disease was reduced 65.2% in seedlings treated with EMBIO actinoPLUS.

| Treatment                                                                       | Disease incidence (%) | Died seedlings (%) | Disease reduction (%) |
|---------------------------------------------------------------------------------|-----------------------|--------------------|-----------------------|
| Untreated seedlings and inoculated with <i>G. boninense</i> (control)           | 93.3 a                | 73.3 a             | 65.2                  |
| Seedlings treated with EMBIO actinoPLUS and inoculated with <i>G. boninense</i> | 50.0 b                | 43.3 b             |                       |



### 3. Field testing – effects of EMBIO™ actinoPLUS in controlling *Ganoderma* disease in field planted oil palm (Shariffah et al, 2015)

- Two treatments were evaluated with 60 seedlings per treatment.
- Seedling treated with EMBIO actinoPLUS in nursery (4X; 50 g/seedling); planting hole (1X, 250 g/hole); and after planting (300 to 600 g/palm). Twelve-month old seedlings were planted 35-45 cm away from *Ganoderma*-infected stump (using seedling baiting technique).
- After 36 months of planting, 6.7% of palms treated with EMBIO actinoPLUS showing BSR symptoms and died due to *Ganoderma* infection compared to the untreated palms (75%).



Seedling treated with EMBIO actinoPLUS



Untreated seedling

| Treatment                               | Died palms due to <i>Ganoderma</i> infection (%) |
|-----------------------------------------|--------------------------------------------------|
| Untreated seedlings (control)           | 75.0                                             |
| Seedlings treated with EMBIO actinoPLUS | 6.7                                              |



# 3. GanoCare™ (Commercial product) (Nutrient fertilizer - beneficial/trace elements)

Jointly developed with UPM and:  
**FELCRA Plantation Services  
Sdn Bhd., Kuala Lumpur**



25<sup>th</sup> International Invention, Innovation and Technology Exhibition (ITEX) 2015 (2 medals):

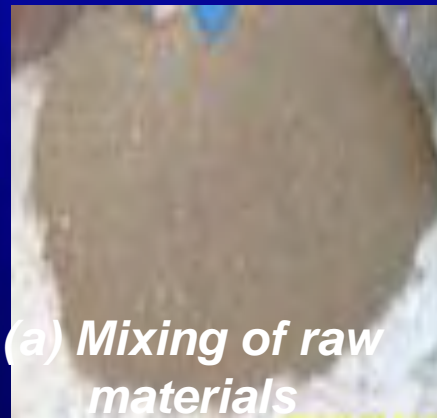
- i). Gold medal
- ii). Malaysia Innovative Product Award.

**Idris et al., (2015).**

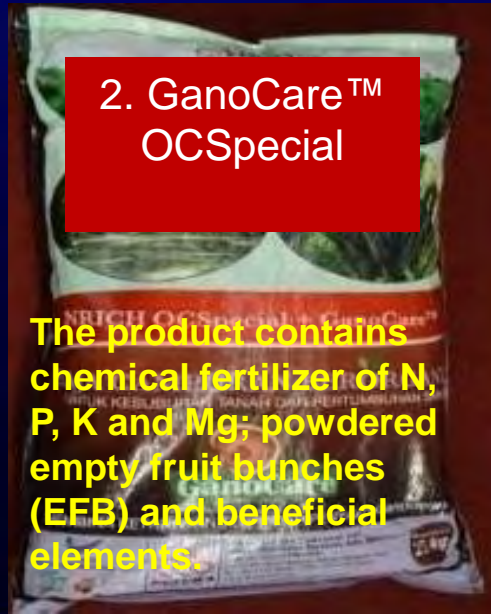


# GanoCare™ (Organic and OCSpecial)

The process of mass production of GanoCare™ was established and patented (PI 2012701060 & PCT/MY2013/000203).



**Compact**



**powder**



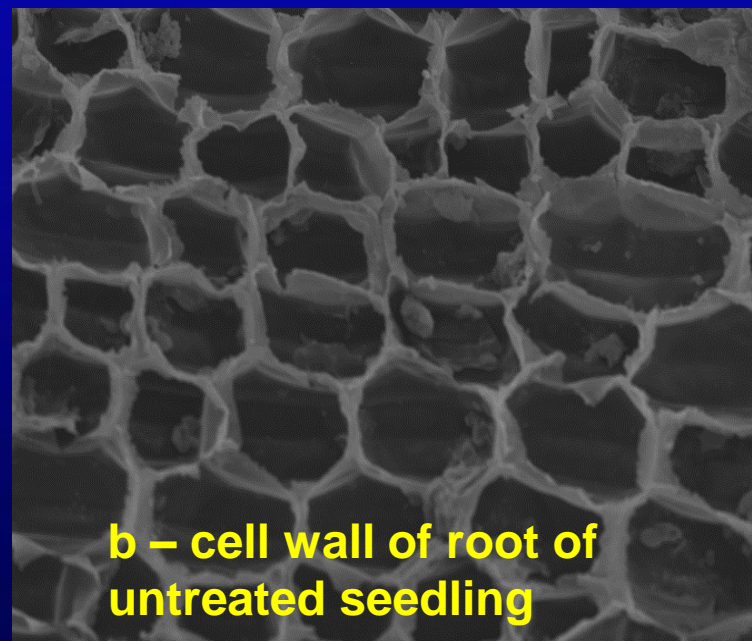
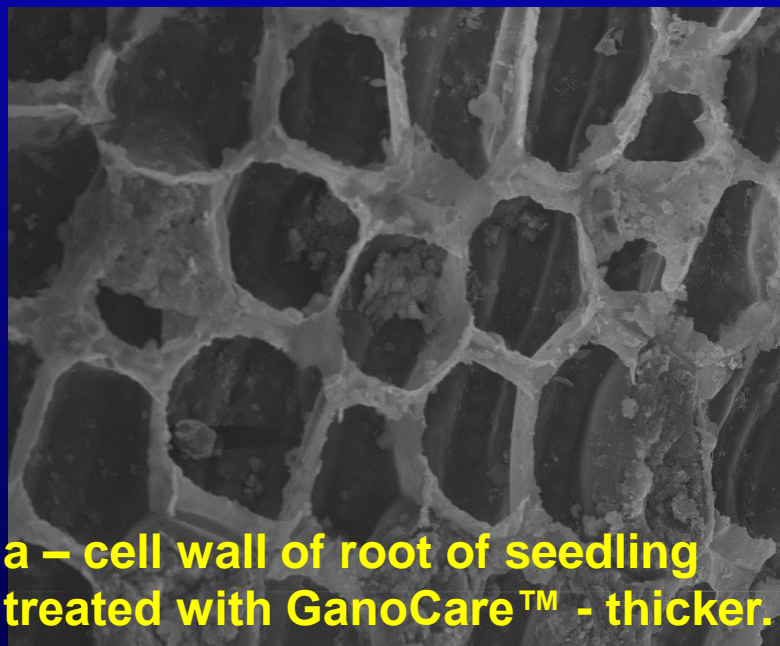
**Pellet**



**MP Pellet**



# 1. Nursery testing – effects of GanoCare™ on the vegetative growth of oil palm seedlings



Scanning electron microscopy (SEM, 450x) showing section of oil palm root. Cell wall of root (a) of seedling treated with GanoCare™ has thicker compared with root of untreated seedling (b).

Najihah, 2014; and Maizatul, 2015



## 2. Nursery testing – effects of GanoCare™ OCSpecial in controlling *Ganoderma* disease in oil palm seedlings

- Two treatments were evaluated with 18 seedlings per treatment.
- Seedling treated with GanoCare™ OCSpecial-1 (6:6:8:2). For control, seedling applied using NPK Blue (12:12:17:2). Fertilizer was applied at monthly intervals (9 times). Seedling was inoculated with *G. boninense* using rubber wood block (RWB) sitting technique.
- After 8 months of inoculation, seedlings treated with GanoCare™ significantly lower disease incidence and died due to *Ganoderma* infection. BSR disease was reduced 77.8% in seedlings treated with GanoCare™.

| Treatment                                                                                 | Disease incidence (%) | Died seedlings (%) | Disease reduction (%) |
|-------------------------------------------------------------------------------------------|-----------------------|--------------------|-----------------------|
| T1 – control seedlings and inoculated with <i>G. boninense</i>                            | 93.0 a                | 90.0 a             | 77.8                  |
| T2 - Seedlings treated with OCSpecial GanoCare™ 1 and inoculated with <i>G. boninense</i> | 40.0 b                | 36.0 b             |                       |





### 3. Field testing – effects of GanoCare™ OCSpecial in controlling *Ganoderma* disease in field planted oil palm

- Two treatments were evaluated with 42 seedlings per treatment.
- Seedling treated with GanoCare™ OCSpecial (OCSpecial 1, 2 and 3) in nursery and field. For control, seedlings were applied using NPK Blue and compound fertilizer (as suggested by FELCRA).
- Twelve-month old seedlings were planted 35-45 cm away from *Ganoderma*-infected stump.
- After 21 months of planting, 4.7% of palms treated with GanoCare™ died due to *Ganoderma* compared to the control (83.3%).



Palm treated with OCSpecial GanoCare™



Control palm

| Treatment                                                              | Dead palms due to <i>Ganoderma</i> infection (%) |
|------------------------------------------------------------------------|--------------------------------------------------|
| T1 – Control seedlings (NPK Blue and compound fertilizer)              | 83.3 a                                           |
| T2 - Seedlings treated with GanoCare™ OCSpecial (OCSpecial 1, 2 and 3) | 4.7 b                                            |



# Biosecurity Plan For Malaysian Oil Palm Industry

- The 'Jawatankuasa Nasional Pelan Biosekuriti Industri Sawit (JNPBIS)' - MPOB, DOA, MPIC, MOA, MPOA, MARDI, oil palm industry was formed.
- MPOB has signed an MoA with CABI, UK in 2013 for development of 'Biosecurity Plan for Malaysian Oil Palm Industry'.
- A total of 691 of pests, diseases and weeds (677 compiled by CABI and 14 compiled by DOA) were reported to be associated with palmae species in 44 oil palm producing countries.
- There are 224 list of pests, diseases and weeds that are absent in Malaysia.
- The key diseases to be prioritized are: *Fusarium oxysporum* f.sp. *elaeidis* (vascular wilt), *Phytophthora palmivora* (bud rot), *Phytopomonas staheli* (sudden wilt), *Bursaphelenchus cocophilus* (red ring) and *Cercospora elaeidis* (leaf spot).



# Biosecurity Plan for Malaysian oil palm industry

## Achievements:

**The Centre for Agriculture and Bioscience International (CABI) has submitted final reports on the Biosecurity Plan for Malaysian Oil Palm Industry, in November 2015.**

- **Summarized information on entry, establishment and spread potentials and economic consequences of the 23 potential pests (insects, diseases and weed) are provided together with their factsheets.**
- **Other emerging threat of exotic pests in Malaysia such as *Parthenium hysterophorus* and red palm weevil will be included.**

## Action plan in 2016:

- **To organise meeting and workshop with government agencies, oil palm industries and stakeholders.**
- **To implement biosecurity plan in Malaysian oil palm industry together with DOA and MAQIS.**



# CONCLUSIONS

- Among oil palm diseases, BSR or *Ganoderma* disease is the most widely studied and knowledge available.
- The *Ganoderma* disease pose a major threat to oil palm industry in the near future, if no control measures is implemented.
- MPOB has transferred several technologies on controlling and managing of *Ganoderma* disease in existing planting and at replanting. Preventive products are available.
- Some prevention and curative treatments developed are being adopted and implemented by oil palm industry and smallholders.



VOLUME  
1

Further Advances in

# OIL PALM RESEARCH

(2000-2010)



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# Thank you for your attention

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