

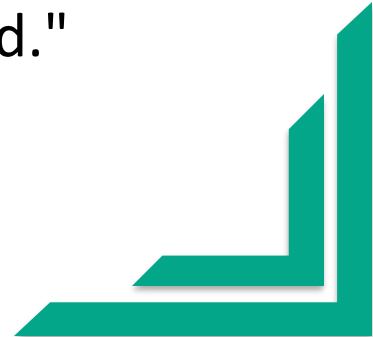
Management of *Ganoderma* BSR in Replanting

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Malaysian Palm Oil Board (MPOB)
SOPPOA–MPOB Workshop
1st October 2025





"Replanting is the renewal of oil palm plantations by removing old and unproductive palms and establishing young, high-yielding and more resilient palms — ensuring long-term productivity, disease management, and sustainability without expanding land."



Why do we need to replant?



 **Yield declines**

 **Opportunity to use new materials with better profile**



Pathogen reservoir

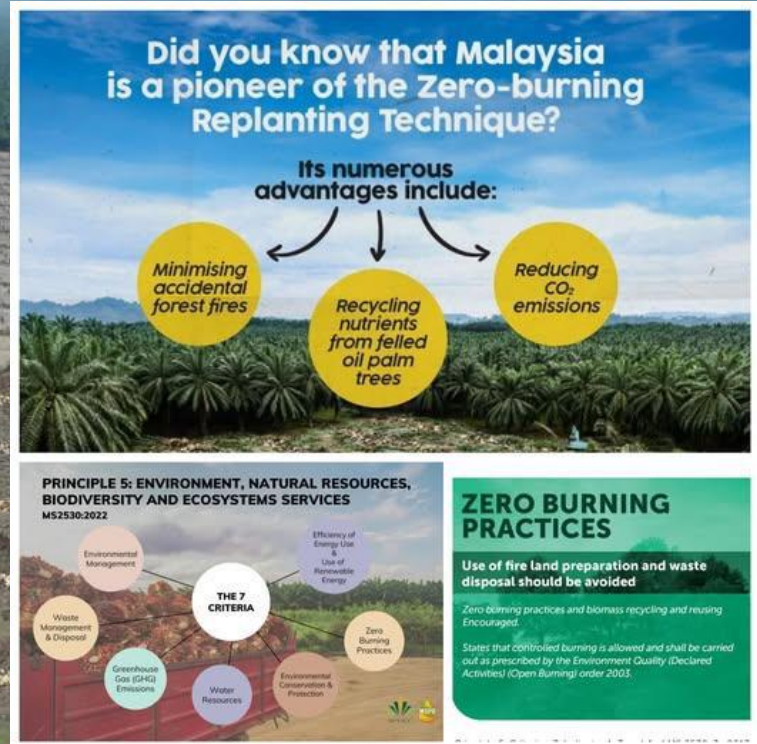
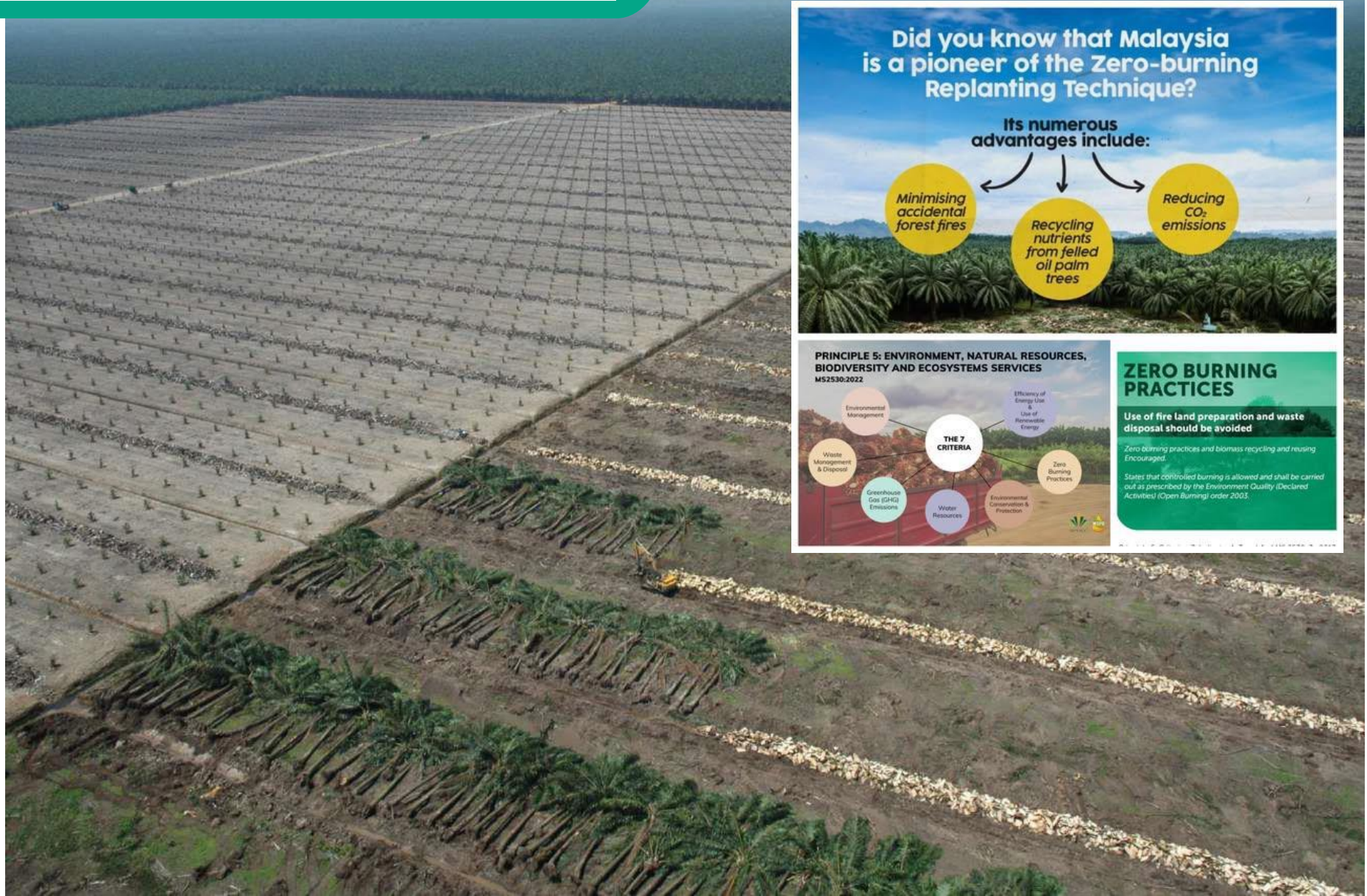


Sustainability

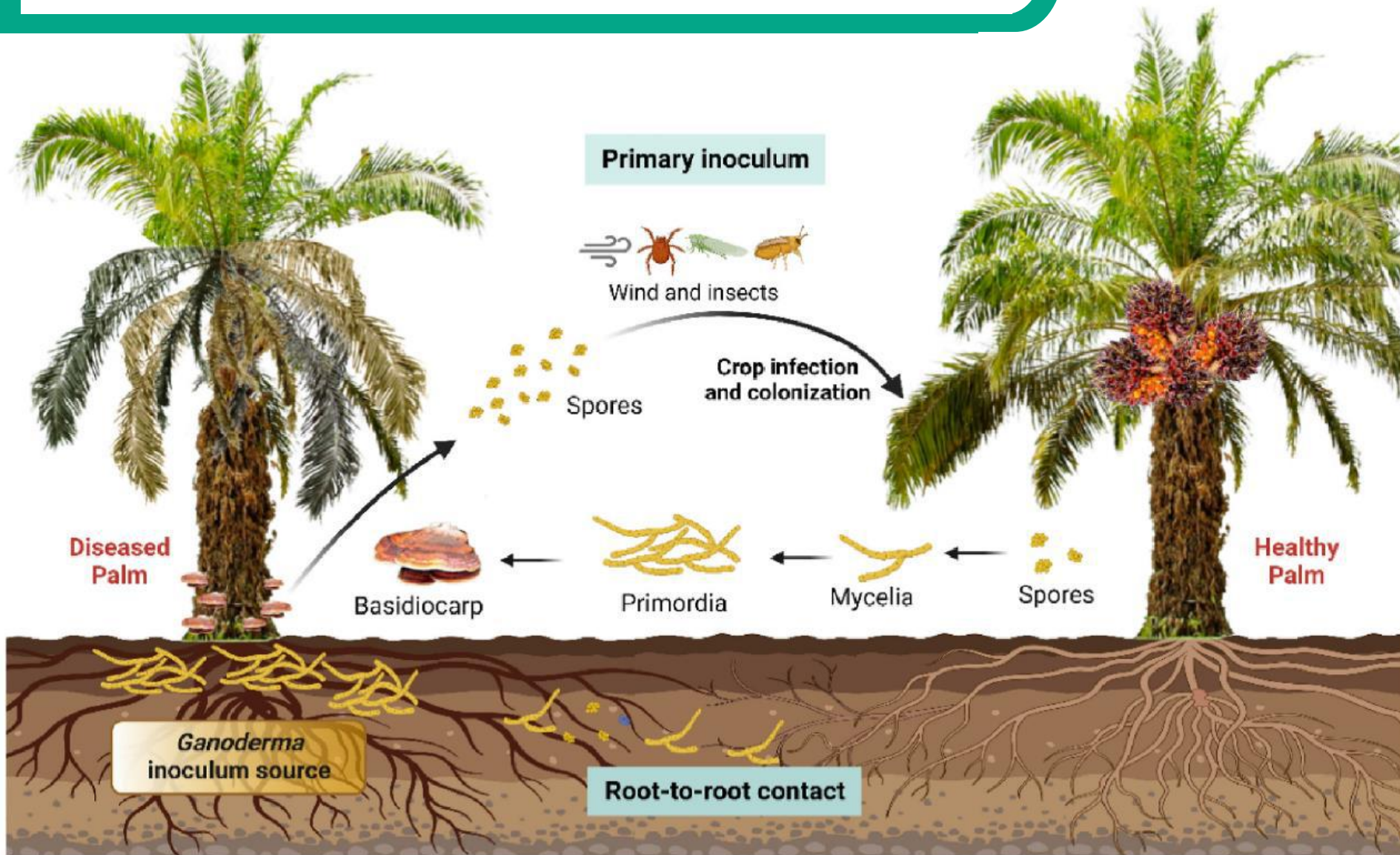


Economic impact

Zero Burning Policy

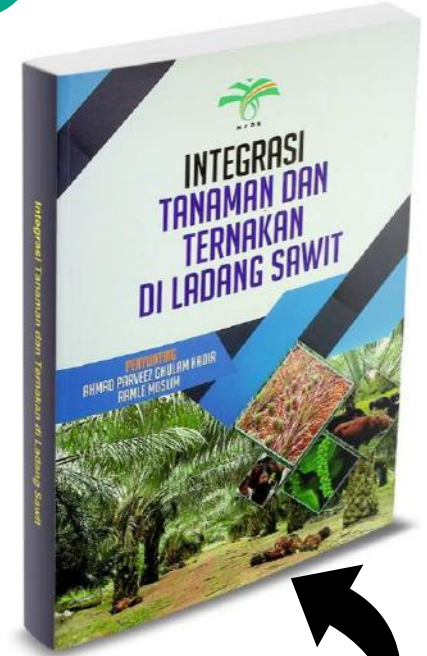


Ganoderma BSR disease in field: Mode of spread



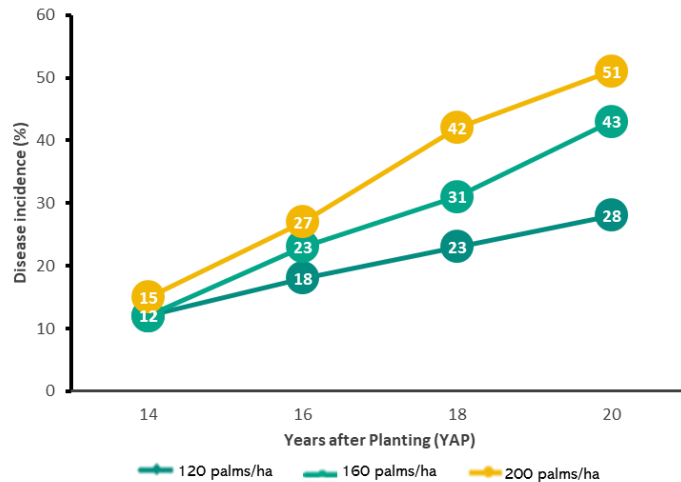
DO NOT underplanting

******As it will increase the chances of a high incidence of *Ganoderma* BSR disease earlier

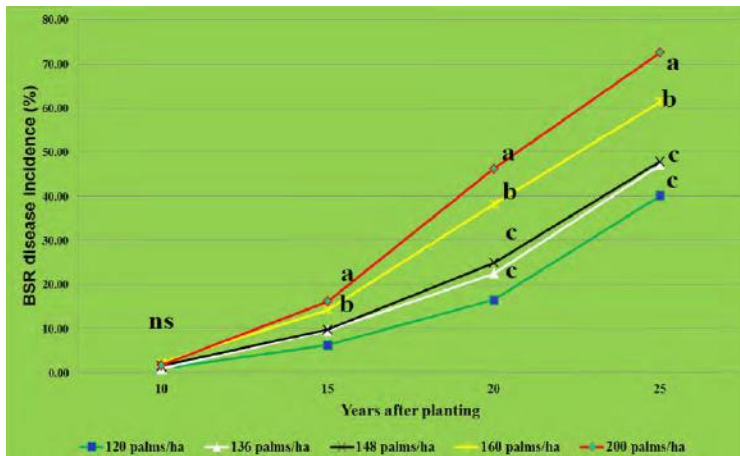
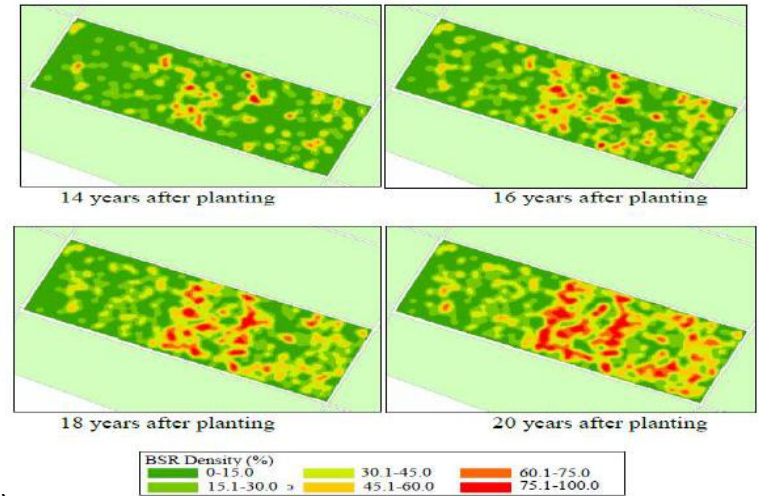


Opted for a strategy to bridge the first 3 years without FFB production in areas that need replanting

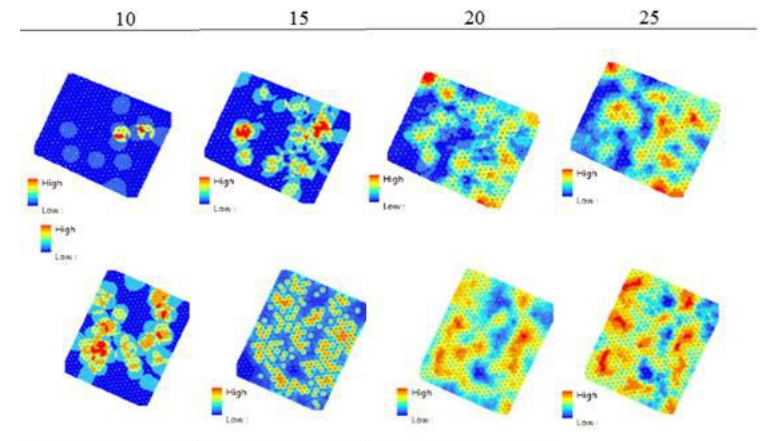
Effect of palm density on *Ganoderma* BSR disease



*No effect by planting densities on disease incidence (Azahar et al. (2014))

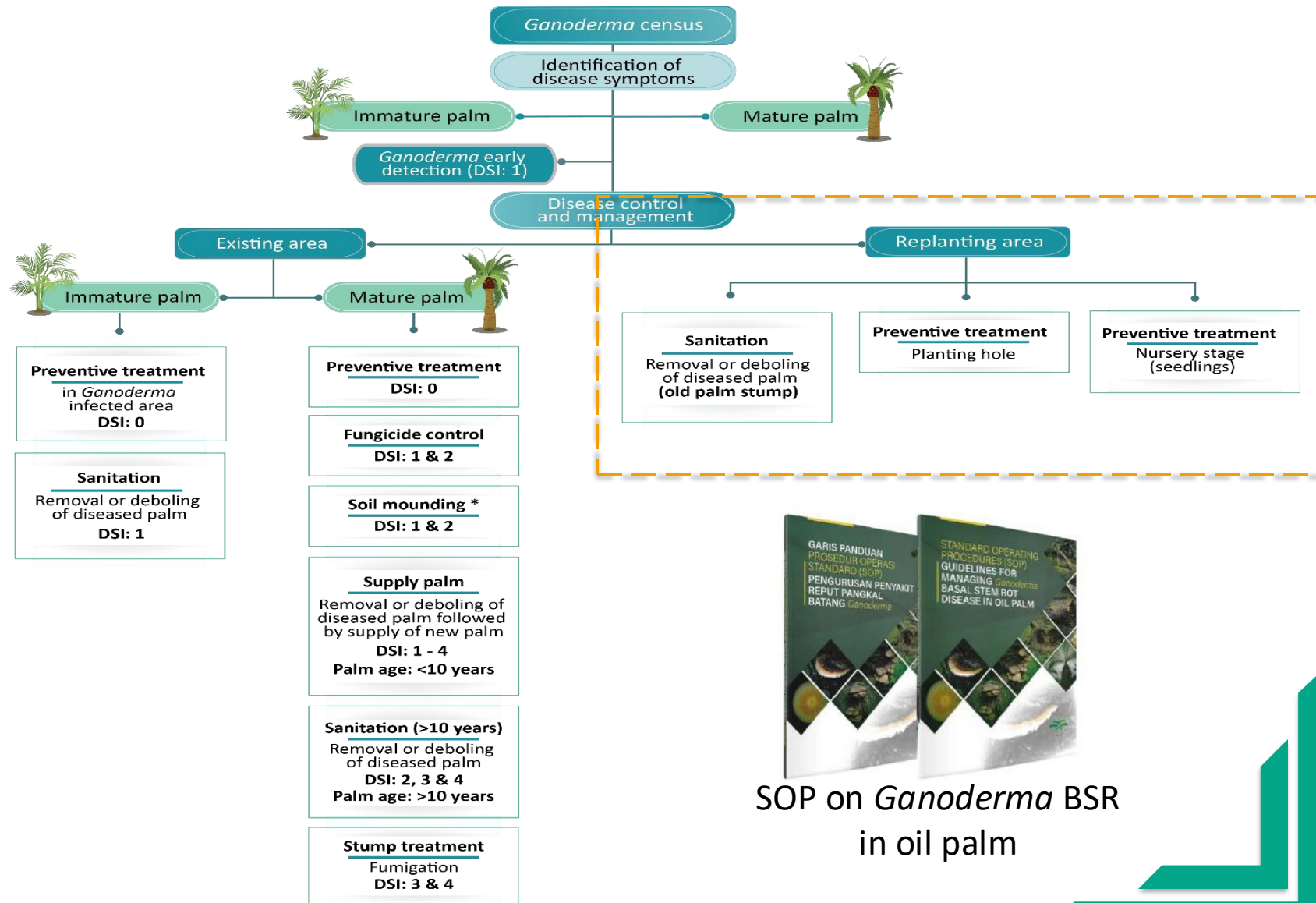


*There is a significant effect by planting densities on disease incidence (Idris et al. (2013))



*kriging image showed a significant patter on the BSR incidence on low (upper side) and high (below) planting densities at 10, 15, 20 and 25 years (Shukri et al. (2020))

Integrated *Ganoderma* Management (IGM) Flow Chart



SOP on *Ganoderma* BSR
in oil palm

Sanitation

Activity to **remove, destroy, or reduce sources of *Ganoderma* inoculum** before and during the establishment of a new planting cycle.



Sanitation technique



1

Census



2

Pushing of palm with an excavator with a special cutler bucket



3

Excavation at 1.5 - 2.0 m (L) x 1.5-2.0 m (W) x 1-1.5 m (D) for 2-3 months



4

Chipping of trunk at thickness < 10 cm



5

Chipped biomass of trunk



6

Arranged chipped biomass (1-1.5 m away)*



7

Planting of new palms

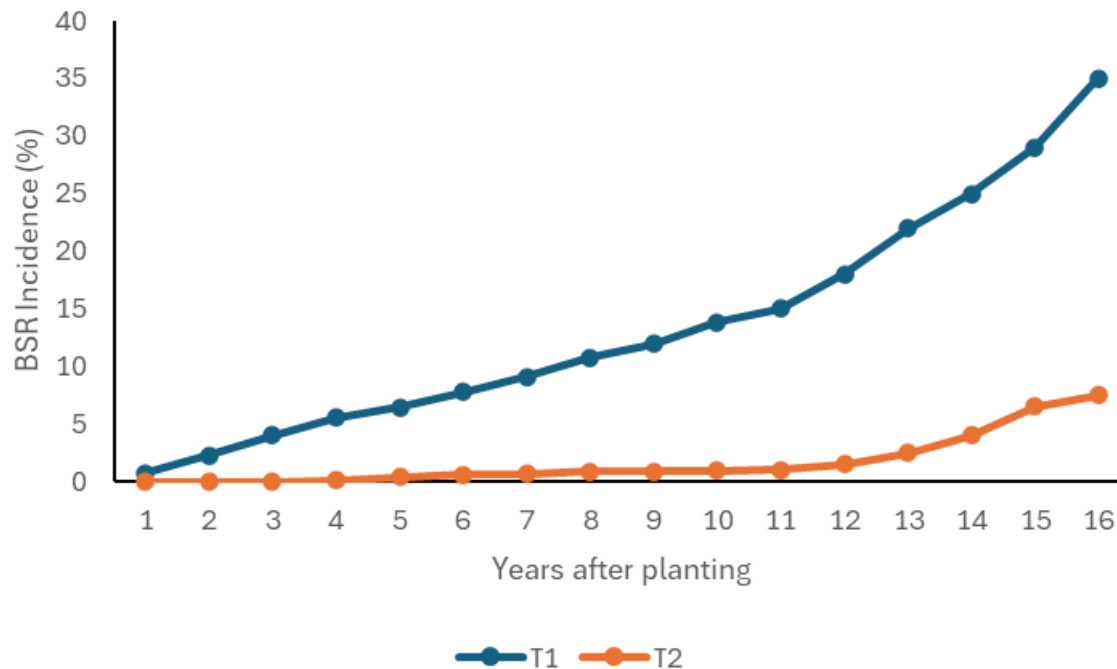
Soil type : Selangor series (coastal)

BSR incidence (1st generation):

T1 (39.9%) and T2 (43.4%)

Planting density (1st generation): 136 palms/ha

(2nd generation): 148 palms/ha



Treatments:

T1 (without sanitation) - estate practices including pushing the old stands, chipping, stacking, and planting new palms.

T2 (sanitation) – estate practices + excavating soil and the all old stumps and roots masses + ploughing along the new replanting row + planting new palm along ploughing areas.

Sanitation by Pulverisation technique

The pulverisation techniques discussed below can be in the form of pulverization:

1) partially decomposed palm chips, 2) standing and 3) newly felled oil palms:

Technique 1:

Pulverize partially decomposed palm chips (Ooi and Heriansyah, 2005)

- 🚜 Excavator felling, chipping, and pulverizing palm biomass. Chipped heaps (≤ 3 layers) were left to decompose for two months before pulverization of the partially decomposed palm biomass by using excavator-mulcher.
- 🚜 The biomass were pulverized heap by heap, starting from the top of the heap and moving downwards
- 🚜 **Benefit:** No additional capital expenditure



Pulverization technique using Technique 1 method

(Source by Ooi Ling Hoak/AAR)

Technique 2: Pulverize standing palm (Ooi and Heriansyah, 2005)

- ✎ EnviroMulcher mounted on an excavator pulverizes palm trunks into fine biomass.
- ✎ To pulverise a palm, the excavator places the EnviroMulcher™ at the highest point possible and cut the palm trunk into 2 and proceeds to pulverise the standing portion of the palm
- ✎ **Benefit:** fast. It takes an **average of 8–10 minutes to mulch the entire palm**



*Pulverization technique using Technique 2
method*

(Source by Ooi Ling Hoak/AAR)

Source: <https://aarsb.com.my/oil-palm-replanting>

Technique 3: Pulverised newly felled oil palms (Ooi and Heriansyah, 2005)

- 🚜 Two excavators fell and line palms for a MountainGoat™. The same excavators also dig up root mass;
- 🚜 Mountain goat is a machine powered by a 750hp caterpillar engine and supported by 2 excavators
- 🚜 Pulverising an entire palm and spreading pulverised chips
- 🚜 MountainGoat™ chipper drum with 10 knives



Pulverization technique using Technique 3 method

(Source by Ooi Ling Hoak/AAR)

Source: <https://aarsb.com.my/oil-palm-replanting>

Technique 4:

Pulverised newly felled oil palms (Ooi and Heriansyah, 2005)

- ❏ A Beaver, with a 0.9×0.3 m cutting blade, severs the root mass by pushing into the ground just below the root bole;
- ❏ The same blade then pushes the palm down and digs up the root bole along with surrounding roots;
- ❏ Two forward and one backward pass pulverize the palm, discharging biomass in rows over the fallen trunks.



Pulverization technique using Technique 4 method

(Source by Ooi Ling Hoak/AAR)

Source: <https://aarsb.com.my/oil-palm-replanting>

Land preparation – Mathews et al. 2021

Mathews et al. (2021) reported the effect of three different method of land preparation in delaying *Ganoderma* BSR in Inland Mineral Soils

Method A: Selective excavation of diseased stumps and vacant points of fallen palms.

Method B: Complete clean clearing by the excavation of all healthy, diseased standing palms, diseased stumps and vacant points of fallen palms, followed by disc ploughing and rotavating of land prior to replanting

Method C: Complete clean clearing by the excavation of all healthy, diseased standing palms, diseased stumps and vacant points of fallen palms, followed by deep ploughing or tilting of soil using an excavator bucket and rotovating of land prior to replanting.



Figure 1 Excavator bucket tilting the soil

Other tools for Ploughing



Howard ripper

- ❖ **Double ploughing was required** when using Howard ripper: first at 30–40 cm depth, then 50–60 cm, making the process time-consuming.
- ❖ In laterite soils, deep ripping was not possible, and only 10–15 cm of the surface could be ploughed.



Fabricated steel ripper mounted on D6 bulldozer

‘Deep ploughing with a fabricated ripper mounted on a bulldozer is a practical approach, removes the primary roots or any tissues accidentally buried under the soil at the time of excavation and filling of soil into the pit’



Roots uprooted from soil during deep ploughing

SUMMARY OF THE DIFFERENT METHODS OF LAND PREPARATION FOR REPLANTING AND
NUMBER OF PALMS AFFECTED BY *GANODERMA* AS PER ANNUAL CENSUS TILL 2020

<i>Field number and hectares of former oil palm planting</i>	<i>Palm stand per hectare prior to replanting</i>	<i>Method of land preparation prior to replanting</i>	<i>Replanted year</i>	<i>Total number of palms planted according to the method of replanting (stand per ha)</i>	<i>Total number of palms cumulatively fallen due to Ganoderma by 2020 ^{1/}</i>
79A/13.7 ha	120 (88.0)	Method A	2006	1 980 (148/ha)	564 (28.5%)
86A/2.7 ha	72 (53.0)	Method B	2008	395 (148/ha)	34 (8.5%)
85A/2.6 ha	88 (65.0)	Method B	2009	390 (148/ha)	23 (5.8%)
90F/1.7 ha	83 (61.0)	Method C	2009	250 (148/ha)	5 (2.0%)

Notes:

Method A - Land prepared by selectively excavating the boles of *Ganoderma* fallen palms and vacant points two years prior to felling at 6 monthly intervals.

Method B - Complete removal of boles of healthy and fallen diseased, and vacant palms, followed by two rounds of disc ploughing and one round of rotavating the land between two windrows.

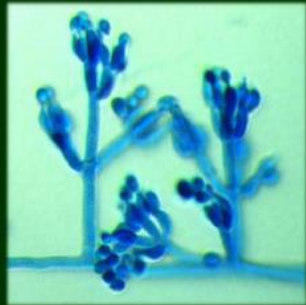
Method C - Excavator method, complete clean clearing land preparation by single excavation or tilting of soil using excavator bucket followed by a round of rotavating the land between two windrows

Parenthesis given is the standing palms or dead palms expressed in percentage

^{1/} Recorded the *Ganoderma* infected fallen dead palms during each harvesting round.

Preventive treatment

Activity to intervene **before a problem occurs**, to reduce or stop the risk of that problem from developing, such as the **application of beneficial microbes**

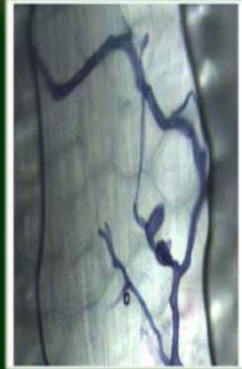


Trichoderma

Trichoderma has been extensively studied for its role to protect oil palm against infection caused by *G. boninense* (Sundram *et al.* 2008, 2013a, 2013b, Angel *et al.* 2016, 2017)

Hendersonia

Endophytic *Hendersonia* was found to be antagonistic against *Ganoderma* and nursery proves the disease reduction in infection (Idris *et al.* 2010; Nurrashyeda and Idris 2013)



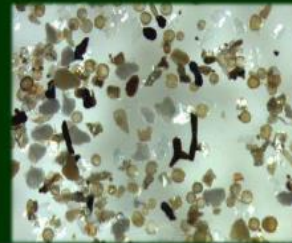
Actinomycetes

Root coloniser and fungal antagonist (Kunoh *et al.* 2000). Rhizosphere actinomycetes reported to inhibit the growth of *G. boninense* (Shariffah Muzaimah *et al.* 2015)

Management of *Ganoderma* using biological control agents

Vesicular Arbuscular Mycorrhiza

Sundram *et al.* (2011) and Sundram *et al.* (2015) shows the ability of VAM act as a BCA by reducing the infection caused by *G. boninense*



Endophytic Bacteria

Endophytic bacteria such as *Burkholderia* spp., *Bacillus* spp., *Serratia* spp., *Pseudomonas* spp. has reported to be able to control *Ganoderma* (Sapak *et al.* 2008; Azadeh *et al.* 2010; Sundram *et al.* 2015)



Application of biocontrol product

At nursery



Apply through soil mixing at
3,6,9 MAP

The recommended rate – depending
on the product of interest

In a planting hole



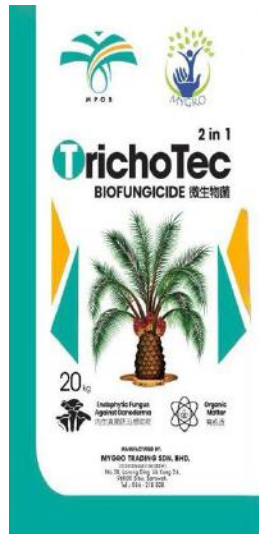
Add one layer of CIRP in the planting
hole followed by the addition of BCA
product

The recommended rate – depending
on the product of interest

Commercial BCA products



GanoEF biofertilizer
a.i: *Hendersonia* GanoEF



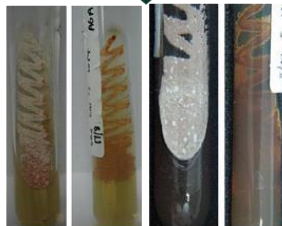
TrichoTec and Tricoshield
a.i: *Trichoderma* sp.



actinoPLUS
a.i: *Streptomyces* GanoSA1.

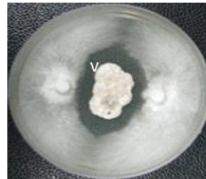
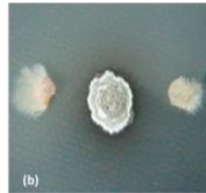
Streptomyces GanoSA1

Isolation of pure culture



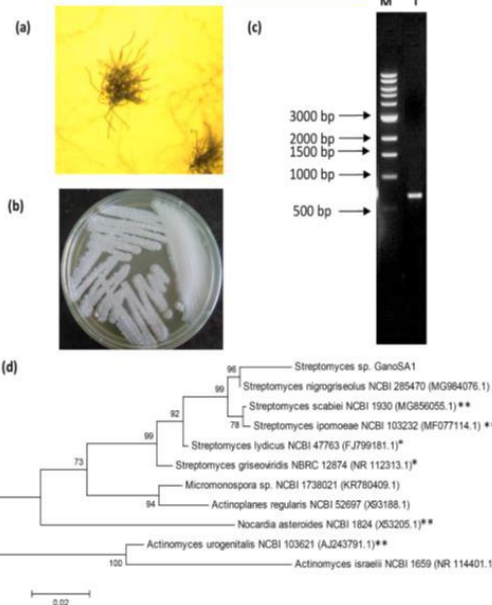
Actinomycetes recovered from soils of *Elaeis guineensis*

In vitro screening

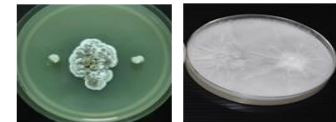


Screening of 129 isolates against *G. boninense* individually

Identification



Formulation and toxicology test



Actinomycetes formulation against *G. boninense* PER71

Toxicological test was carried out at School of Pharmaceutical Sciences, University Sains Malaysia (USM), Penang

Acute oral toxicity study – to provide information on health hazards likely to arise from short-term exposure to a product tested via the inhalation route.

Acute dermal toxicity study – to identify the possible hazard to a population repeatedly exposed to the test substance.

R&D collaboration

EMBIO™ actinoPLUS

Field evaluation (seedling baiting)

Field evaluation (replanting)

Nursery evaluation

The nursery evaluation was done to evaluate the effect of *Streptomyces* GanoSA1 towards plant growth and *Ganoderma* infection



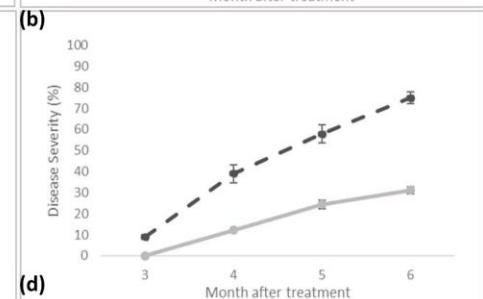
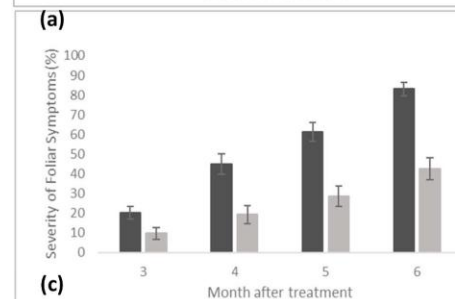
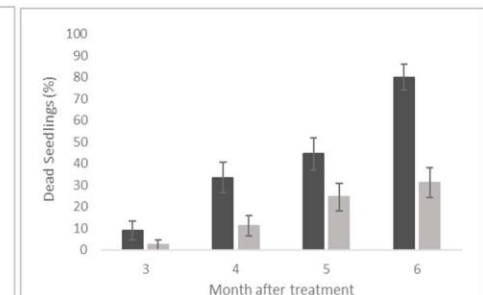
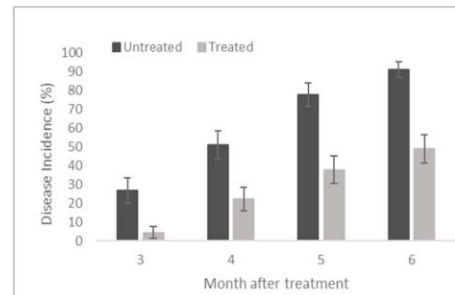
The Effect on plant growth

The effect of *Streptomyces nigrogriseolus* GanoSA1 on disease and vegetative growth of oil palm.

Treatment	Control	<i>S. nigrogriseolus</i> GanoSA1 powder
Disease assessment		
Disease incidence (%)	91.11 ± 4.29 ^a	48.89 ± 7.54 ^b
Severity of foliar symptoms (%)	83.11 ± 3.29	42.45 ± 5.57 ^b
Dead seedlings (%)	80.00 ± 6.03 ^a	31.11 ± 6.98 ^b
Disease severity (external, %)	75.00 ± 2.79 ^a	31.11 ± 1.57 ^b
Disease severity (internal, %)	88.89 ± 2.91 ^a	43.32 ± 4.94 ^b
AUDPC (unit ²)	151.94 ± 24.07 ^a	52.22 ± 7.03 ^b
Disease reduction (%)	—	63.01 ± 4.99 ^a
Vegetative growth		
Number of fronds	11.67 ± 0.28 ^a	13.278 ± 0.38 ^b
Plant height (cm)	106.44 ± 2.32 ^a	116.27 ± 2.25 ^b
Stem girth (cm)	50.37 ± 1.53 ^a	58.73 ± 1.35 ^b
Root mass (g)	130.58 ± 1.1 ^a	165.52 ± 0.67 ^b
Leaf mass (g)	255.59 ± 1.78 ^a	272.6 ± 3.35 ^a



The Effect on *Ganoderma* infection



Field evaluation (seedling baiting)

The assessment was done based on the observation of disease symptoms and the presence/absence of *Ganoderma*

EFFECT OF *Streptomyces* GanoSA1 POWDER IN CONTROLLING *GANODERMA* DISEASE IN OIL PALM, 36 MONTHS AFTER PLANTING (MAP) USING SEEDLING BAITING TECHNIQUE

Treatments			Palms dead due to <i>Ganoderma</i> infection (%)		
			12 MAP	24 MAP	36 MAP
T1	-	Untreated seedlings (control)	8 ^a	20 ^a	75.0 ^a
T2	-	Seedlings treated with <i>Streptomyces</i> GanoSA1	0 ^b	3 ^b	6.6 ^b

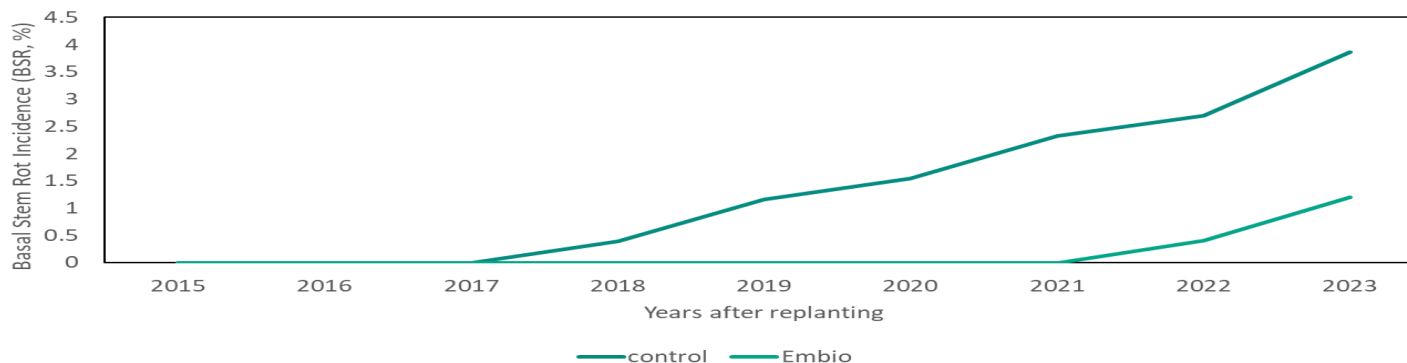


Field testing of *Streptomyces* GanoSA1 powder, a) seedling treated with EMBIO™ actinoPLUS (healthy), and b) seedling untreated (with symptoms of *Ganoderma* infection).

Field evaluation (Replanting)

The assessment was done based on the observation of disease symptoms and the presence/absence of *Ganoderma*

EFFECT OF *Streptomyces* GanoSA1 on *Ganoderma* BASAL STEM ROT DISEASE IN OIL PALM AT REPLANTING





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Thank you

