MPOB

Transforming the Upstream Oil Palm Sector through Innovations

Norman Kamarudin, Zulkifli Hashim,
Idris Abu Seman, Ramle Moslim

MALAYSIAN PALM OIL BOARD, P.O.BOX 10620, 50720 KUALA LUMPUR

Issues in Malaysian oil palm industry

- Stagnating national average yields
- Labour issues – mechanisation
- Pest and disease

- Have we done different over the last 100 years?
- Target of 26t FFB/ha is it achievable?;

Challenges and Innovations in oil palm management

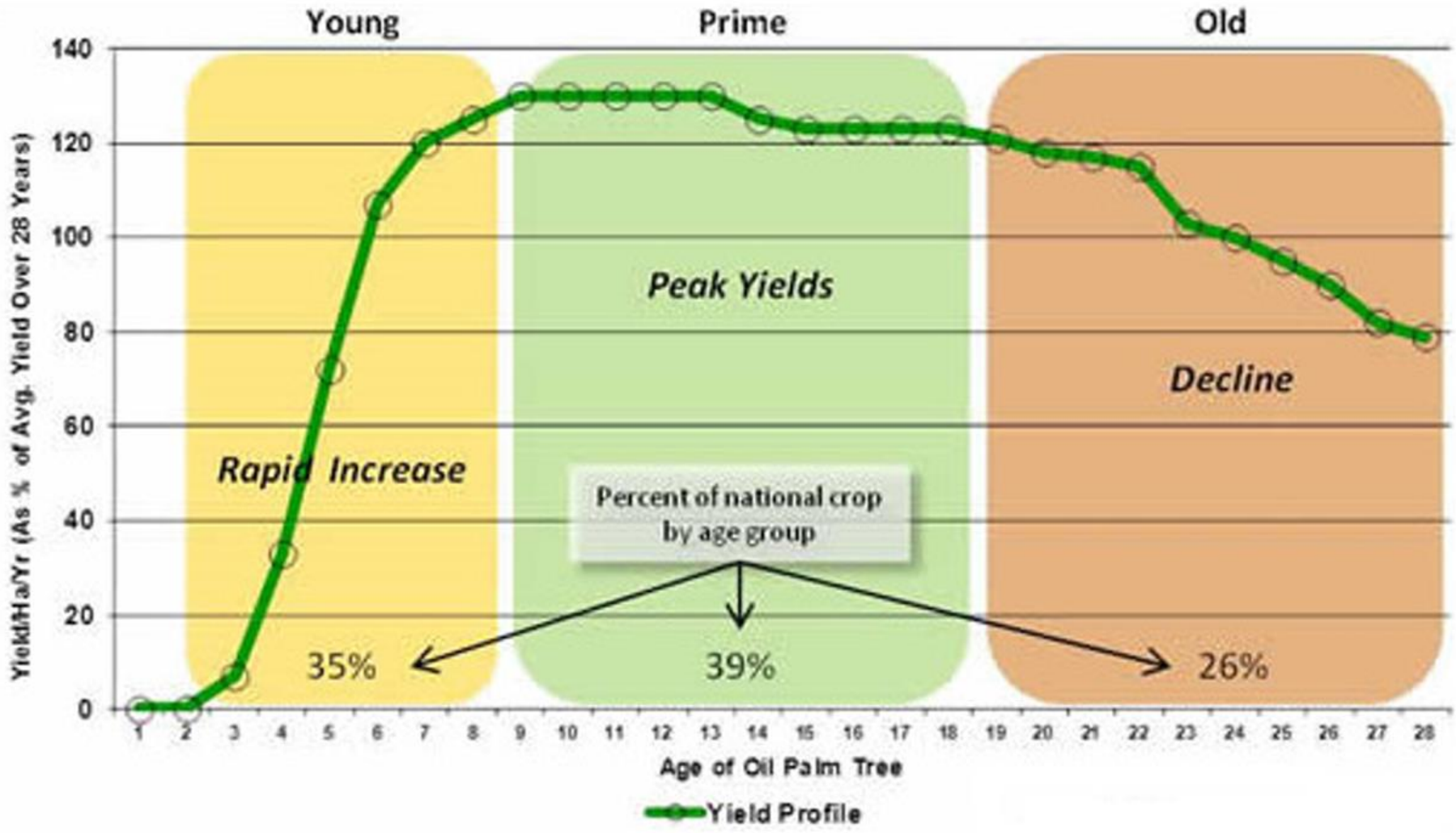
- Innovations should be inculcated for the oil palm industry to remain competitive.
- R&D and innovations should respond to the increasing production costs, shortage of land, labour and sustainability issues.
- Technologies should conform to Good Agricultural Practices (GAP), towards maximising oil palm yield.

Profit – are we getting enough from the soil to gain high yield?

- Oil palm is planted on various types of soils

The need to transform:

- **Classification of peat soils**
  - Management in terms of water and nutrients
  - Avoid planting on deep peat
- **Balanced nutrients for optimal growth**
  - Identify soil series
  - Apply balanced formulation fertilisers


Young
Prime
Old
Yield/Ha/Yr (As % of Avg. Yield Over 28 Years)
140
120
100
80
60
40
20
0
Peak Yields
Decline
Rapid Increase
Percent of national crop by age group
35%
39%
26%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Age of Oil Palm Tree
Yield Profile

Balanced fertiliser formulation

- The potential FFB and oil yield could be realized by applying the optimum quantity of balanced fertilizer
- Oil palm needs balanced ratios of fertiliser (N, P, K, B and Mg) in order to be productive.
- Ratios have been derived from more than 20 years historical data of fertilizer trials throughout the country
- Maximizing profit, reduce wastage and adverse impact on environment.

Innovative Replanting Technique for Oil Palm

- Oil palm seedlings are planted direct into the rows of the old palm biomass residues.
- The amount of biomass contains significant amounts of nutrients, recycled for succeeding young palms.
- Reduce chemical fertilizer inputs by 50% over five years without affecting the growth and yield of the succeeding palms.

Problems in planting oil palm on peat soil

Haphazard leaning
Low nutrients
FFB evacuation

Mechanically Forced Unidirectional Leaning of Oil Palm on Peat

- The young palms were forcibly pushed using an excavator to lean in one direction
- the mechanically forced palms would lean progressively and unidirectional

Mechanically Forced Unidirectional Leaning of Oil Palm on Peat

Step 1: When the palms reached 30 months old, they were forcibly pushed using an excavator to lean at 45^{o} in one direction

Step 2: Soil mounding of palms was conducted.

Step 3: The soil was compacted or levelled and cleared of any stumps or lumber along the harvesting paths

Step 4: Pruning of damaged fronds was carried out.

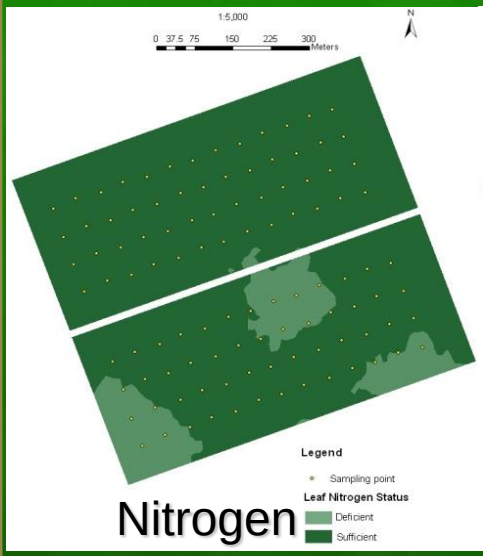
Mechanically Forced Unidirectional Leaning of Oil Palm on Peat

- Helps alleviate haphazard leaning of palms on peat, subsequently minimize FFB yield losses;
- Providing good in-field accessibility, thus increase the efficiency of field operations; and
- Having a more uniform palm height, thus increasing the productivity of harvesting

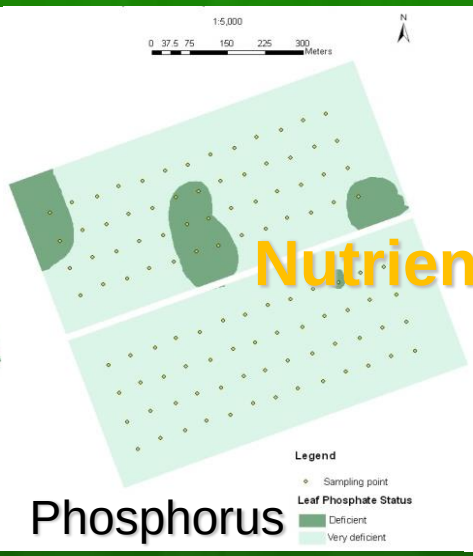
Geospatial Technologies for Precision Agriculture

- Precision Agriculture technologies involving Geospatial mapping technologies can be utilised for:
  - Targeted fertilizer application for gaining higher productivity of the crop.
  - Monitoring pest and disease outbreaks

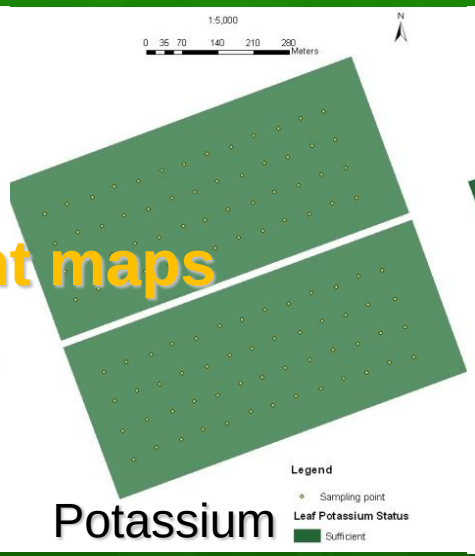
Nutrient maps



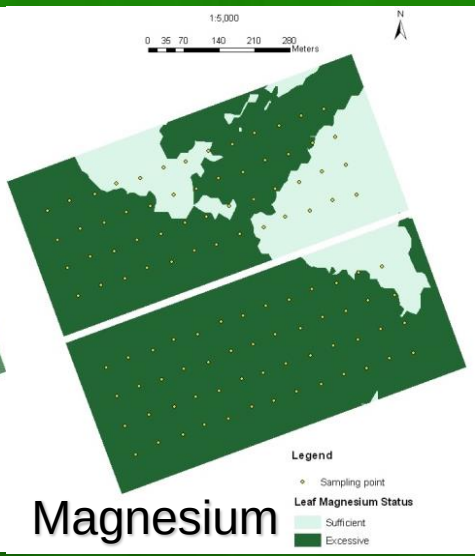
Nitrogen



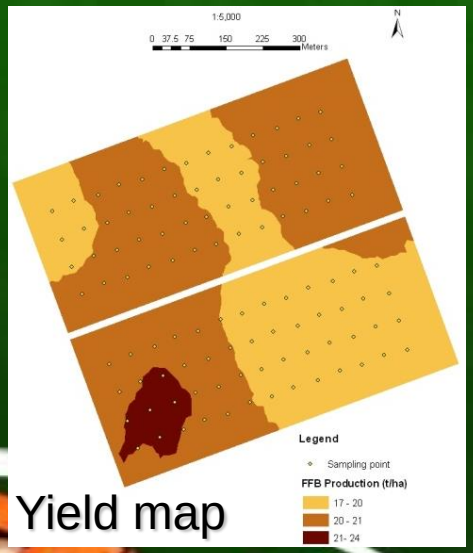
Phosphorus



Potassium

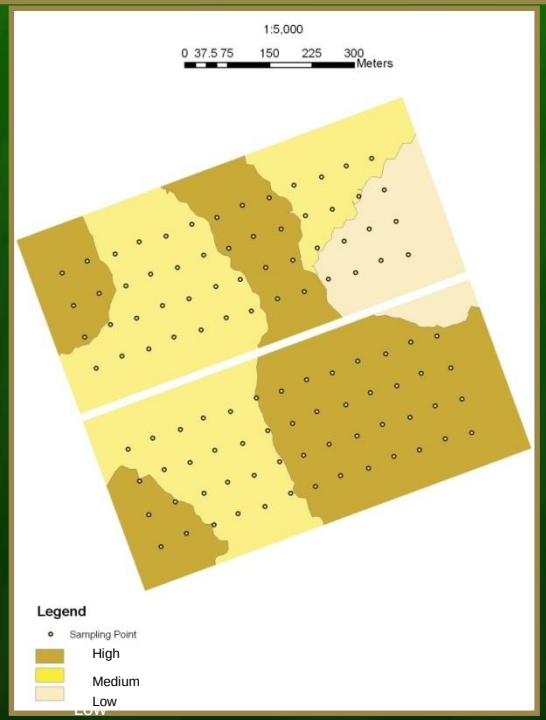


Magnesium



Yield map

Variable Rate Fertilizer Recommendation Map



MPOB

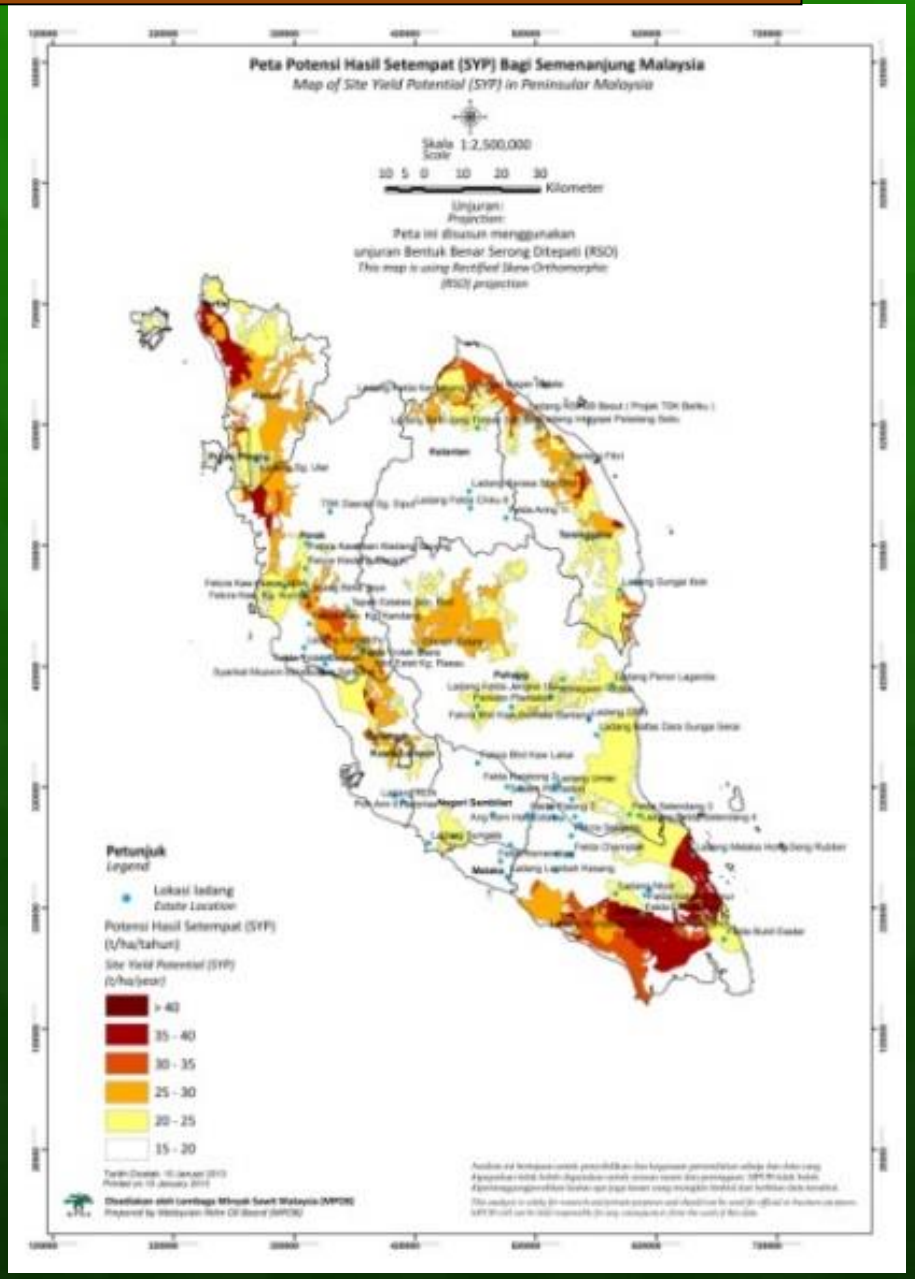
Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

Geospatial Technologies for Precision Agriculture

INCREASE FFB YIELD

- 666 low yielding estates (<16 t/ha/yr) with **high SYP (25-40 t/ha/yr)** had been determined.

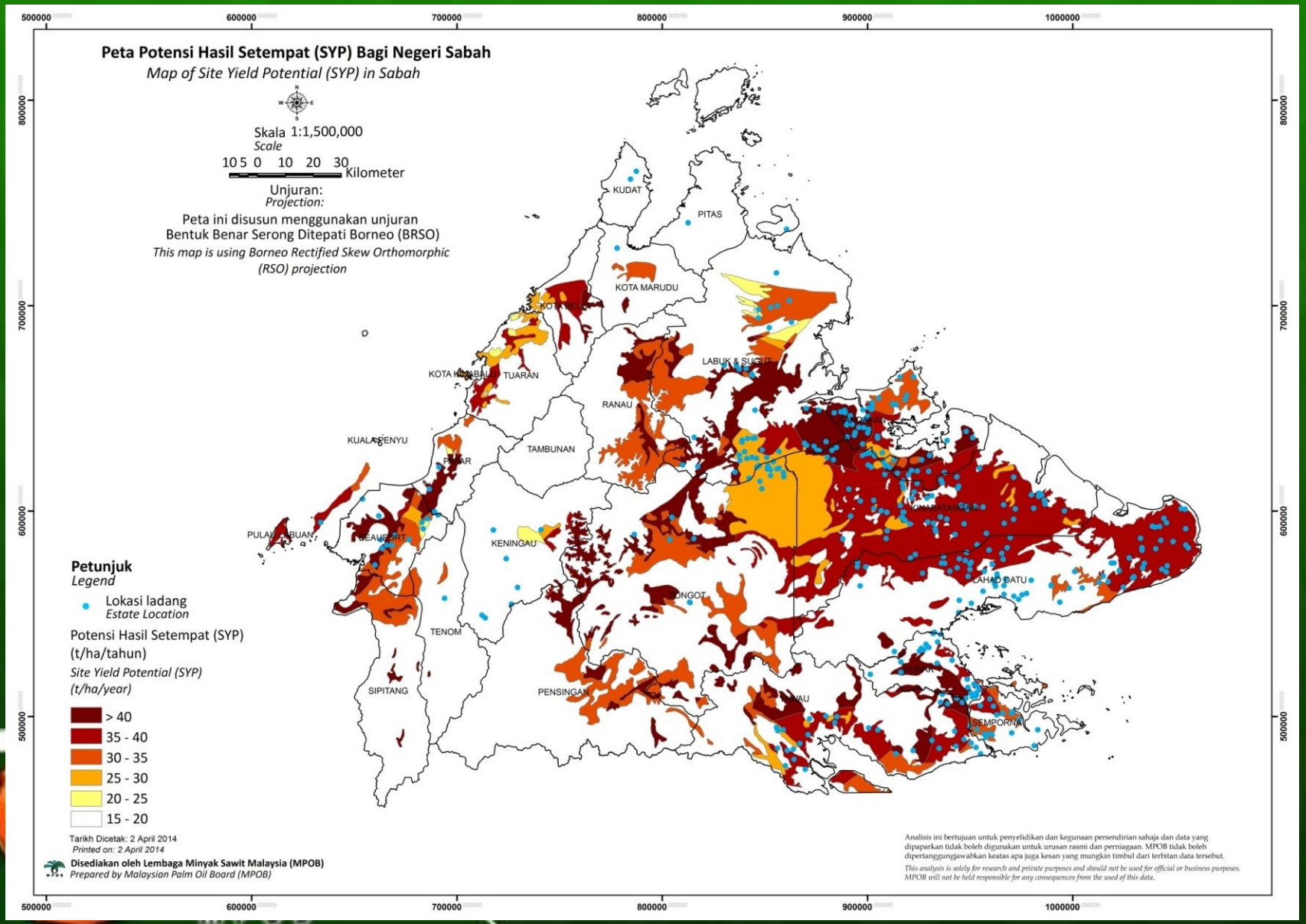
- Agronomic advisory visits will be conducted to these low yielding estates.



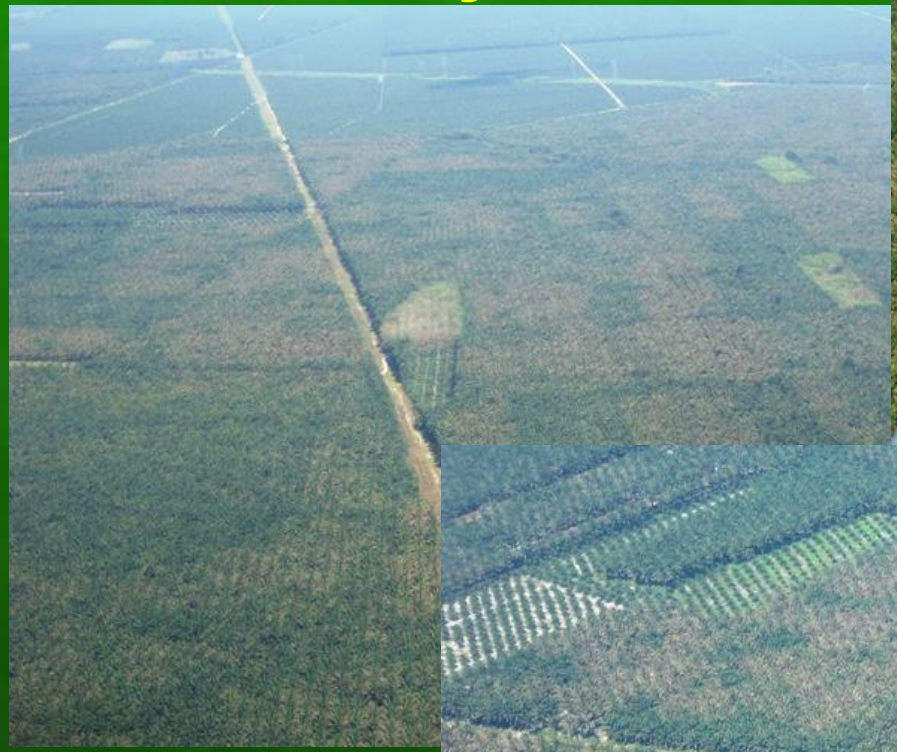
MPOB

Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

Geospatial Technologies for Precision Agriculture



Now, everyone can fly



MPOB

Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

…but not everybody wants to fly

UAV for Mapping

- Pests and diseases occurrences should be closely monitored
  - potential to reduce the overall productivity of the crop.
  - Serious damage can cause yield reductions of 43% over the next 2 years of the crop
- IPM (Integrated pest management) remain a viable yardstick for sustainable production of palm oil.

Planet – are we polluting the environment with toxic chemicals?

- Plantations use chemical pesticides to control pests

The need to transform:

- **Use safer chemicals – biopesticides**
  - Bacillus thuringiensis (BT) - bagworms
  - Metarhizium – rhinoceros beetles
- **Vigilant to pest occurrence**
  - implement census and threshold levels
  - Identify pest and beneficial insects

Integrated Pest Management (IPM) for Major Insect Pests

- IPM has been implemented for the control of bagworms nationwide.
- Integrated management systems have been implemented using biological agents, *Metarhizium anisopliae* and *Oryctes rhinoceros* viruses.

Handover of beneficial plants to the smallholders

EMULSIFIABLE CONCENTRATE *Bacillus thuringiensis* FOR CONTROLLING BAGWORM OUTBREAK BY AERIAL SPRAYING

- Ecobac-1 (EC) is based on *Bacillus thuringiensis* (Bt) for controlling bagworms.
- Suitable for IPM of bagworm via aerial spray.
- Effective for controlling extensive area of bagworm outbreak in oil palm plantation.

Ecobac-1 (EC)

Benefits

- Environmental-friendly product
- Persists one week on the foliage for bagworm control.
- Cost effective and compatible other biological agents.
- Reduce chemical usage

Aerial spraying of Ecobac-1 (EC)

Strategies for controlling insect pests

The need to transform:

- Environmental manipulations
  - to increase the population of natural enemies
  - to reduce conduciveness of possible breeding sites for insect pests
  - To reduce use of chemical pesticides
- Trapping adult insects to reduce population of the next generation

Nectar producing plants for controlling bagworms

Cassia cobanensis

Turnera subulata

Euphorbia heterophylla

Predators and parasitoids species – *Natural enemies of bagworms*

Cosmolestes picticeps

Sycanus dichotomus

Tachninidae

Dolichogenidea metesae

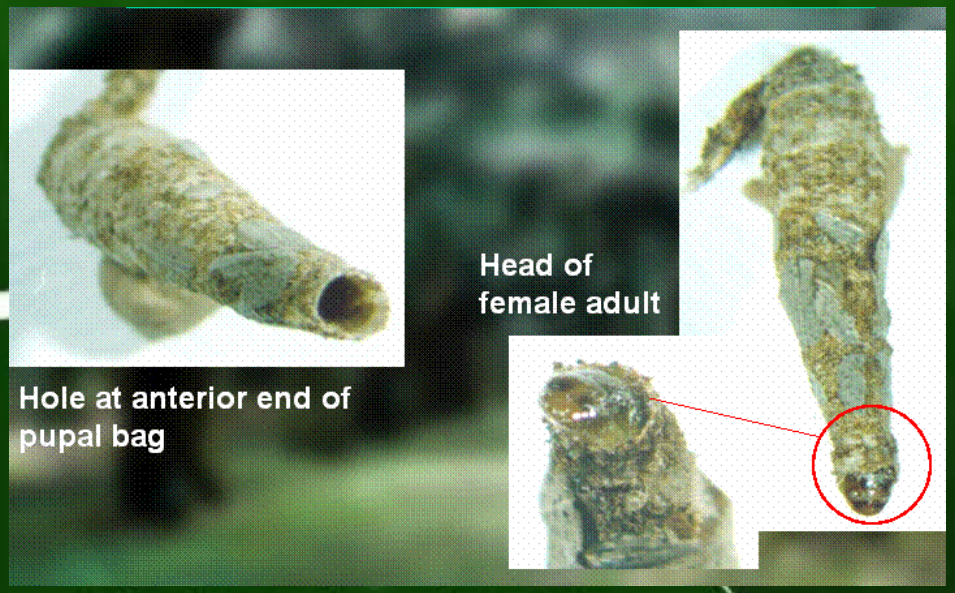
Goryphus bunoh

Brachymeria carinata

STICKY TRAP FOR MASS TRAPPING OF THE BAGWORM IN OIL PALM

Using the receptive female of the bagworm, *Metisa plana,* as bait to lure and capture many male moths onto sticky vane traps.

Utilising the female stage of the bagworm pest to control its population



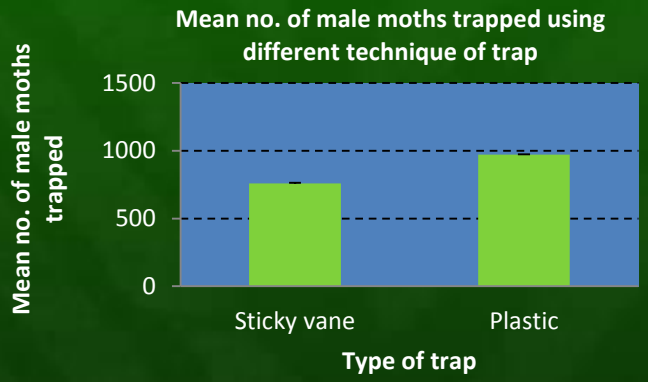
Moths captured on sticky trap

Sticky vane traps hung onto wooden poles

Pheromone trapping in smallholder plantations infested with the bagworm, *Metisa plana*

Pheromone trapping

Items	Trapping technique		%
	Sticky vane	Plastic	
Productivity (male moths trapped/trap/day)	36.1±1.2	46.2±2.9	+28
Cost (RM per unit)	31.70	14.90	-53
Sticky surface area, cm^2	900	3,750	+316



- By mass trapping the male adults, percentage of mated females had reduced, hence lowering the population of the subsequent generation of bagworm.

IPM OF BAGWORMS

Pheromone traps control the male moths, hence reduced mating occurence

Aerial spray of Ecobac-1 (EC)

Control

Control

- Enemies of bagworms
- Require food/ nectar of *C. obanensis*

TRAP FOR AUTO-DISSEMINATION OF Metarhizium TO CONTROL *O. rhinoceros*

Dissemination Concept : Attract, infect and release
Density of trap : 1/5-10 hectar. Filling of spore solution : every 3 days

Trap design showing every compartment

Placement of inoculation disc

MPOB
Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

EFFECTIVENESS

- 85-95% escape from the trap, dead as early as 15 - 30 days , 100% dead at 45 days
- 75-95% escaped adult infected with Metarhizium.

Placement of dissemination trap in the field

- Portable trap, easy to use with less operational time
- Trap design protects pheromone & pathogens from detrimental environmental factors.
- Reduce chemical usage.
- An environmental friendly bio-control agent.

POWDER FORMULATION ORY-X FOR CONTROLLING *Oryctes rhinoceros*

ORY-X ai 2.5 x 10^{12} cfu/kg

- Higher spores viability 9 months after storage.
- Still effective even after 7 & 15 months of storage.
- Easy handling, transportation and field application.

Powder formulation of Metarhizium

Application by tractor in flat areas

MPOB
Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

Oryctes rhinoceros nudivirus (OrV) FOR CONTROLLING *Oryctes rhinoceros*

- Discovered in 1962 in Malaysia (Dr Huger)
  - Infects and kills adults & larvae.
  - Introduction of OrV in Pacific Regions (1970)
    + Adults efficient vecto.
    + Adult population & palm damage reduced after 1-2 years.

Morphological appearance of OrV

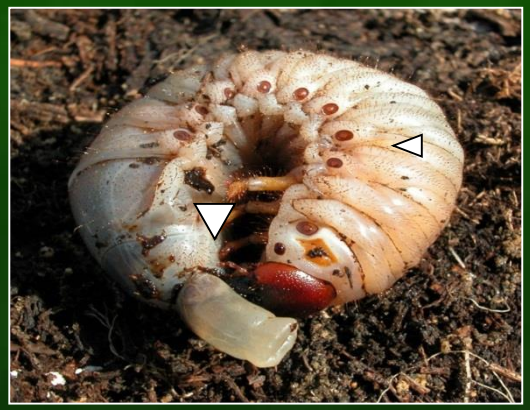
RELEASING ADULT BEETLES INTO THE FIELD

Virus solution

Inoculation of virus

Healthy

Infected



Prolapsed rectum

MPOB

Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

TERMITE CONTROL WITH WATER-TABLE MANAGEMENT

Coptotermes curvignathus

Increasing water-table in peat areas can force termite to soil surface

Adjustable weirs made from sand bags to increase water-table to 15-30 cm

MPOB
Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

RUBBER WOOD STAKE FOR TERMITE DETECTION

installing

removing

collecting & identification

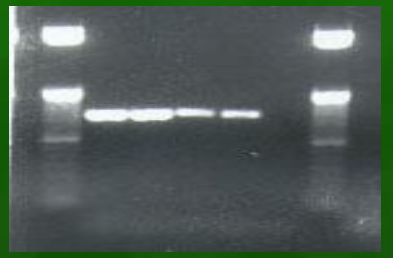
Ganoderma – Oil Palm Disease

- Ganoderma, which causes the basal stem rot disease, remains an important and chronic oil palm disease
- Public awareness on the dangers of this disease need to intensified
- Offering possible actions to minimize the risks of the disease.

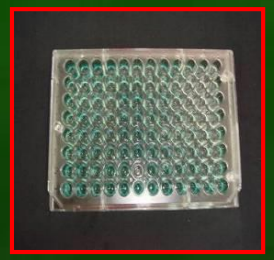
Early Detection of *Ganoderma*

1. Culture based – Ganoderma Selective Medium (GSM)

2. Molecular DNA-based
   i. PCR technique for detection of *Ganoderma*
   ii. Multiplex PCR-DNA Kit for detection and identification of *Ganoderma* species in oil palm



3. Immunoassay Protein-based – ELISA-polyclonal antibody for detection of *Ganoderma*



4. Biosensor-based - GanoSken tomography for early detection of *Ganoderma* infection in oil palm

CONTROL AND MANAGEMENT OF *GANODERMA* DISEASE

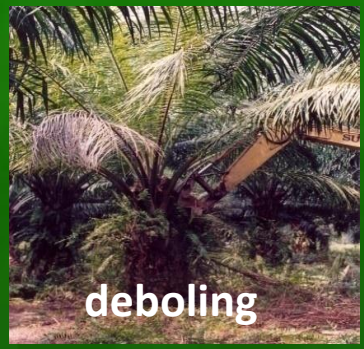
1. In existing plantings
2. At replanting

- to prolong the productive life of the infected palms.
- to eradicate the *Ganoderma* inoculum.
- to minimize the inoculum burden carried over in the subsequent planting.

DISEASE CONTROL AND MANAGEMENT IN EXISTING PLANTINGS

A) PREVENTIVE CONTROL :

1. Sanitation by removal (deboling) of diseased palm
2. Stump treatment with fumigant dazomet
3. GanoEF biofertilizer
4. EMBIO actinoPLUS biofertilizer


deboling

B) Curative Control/Prolonging the productive life of the *Ganoderm* palms:

1. Fungicide hexaconazole (trunk injection)
2. Soil mounding


dazomet


hexaconazole


Soil mounding

MPOB
Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

Sanitation Technique At Replanting

- In Segamat – after 16 years, BSR incidence was lower in sanitation areas (13.4%) compared to 51.6% without sanitation. Disease reduction of 38.3%.

- In Sepang – after 16 years, BSR incidence was lower in sanitation areas (7.5%) compared to 35% without sanitation. Disease reduction of 27.5%.

Biocontrol agents for Ganoderma control

- Production of biocontrol agents formulated as a biofertilizer shows good promise towards minimizing risks of this disease, both at the nursery and in the field.

GanoEF Biofertilizer

Biological Control of Ganoderma Disease

✓Incorporated *Hendersonia* GanoEF1 (endophytic fungus) into organic and inorganic fertilizer.

✓ It is a formula for *Ganoderma* prevention, soil fertility and vegetative growth.

✓ The product has significantly reduced (70%) the *Ganoderma* infection in oil palm (nursery evaluation).

EMBIO actinoPLUS Biofertilizer

Biological Control of Ganoderma Disease

✓ Incorporated *Streptomyces* GanoSA1 (soil actinomycete) into organic fertilizer.

✓ It is a formula for *Ganoderma* prevention, soil fertility and vegetative growth.

✓ The product has significantly reduced (60%) the *Ganoderma* infection in oil palm (nursery evaluation).

People – can we be more productive with less labour?

ACTIVITIES IN PLANTATION

HARVESTING

LOOSE FRUIT COLLECTION

INFIELD FFB EVACUATION

CROP CARE AND FIELD MAINTENANCE

CHALLENGES FOR MECHANISATION

LABOUR TO LAND RATIO
COST OF MACHINES
APPLICABILITY AND VIABILITY OF MACHINES
AFTER SALES SERVICE

CHALLENGES FOR MECHANISATION

- Increasing costs – fuel, spare-parts etc
- Land topography – hilly terrain & deep peat
- Infrastructure – access road, drainage etc.

The need to transform:

- Increase the interest towards mechanization, reduce dependence to manual labour
- Increase back-up service by machine suppliers
- Provide proper system, division of labour, mechanic, mechanization team

Mechanisation: Harvesting Technologies

Mechanisation in harvesting, evacuation and transportation of FFB to increase productivity and reduce labour requirements

Aluminium pole

The Grabber

Beluga

Motorised cutter cantas™ MPOB Malaysian Palm Oil Board

CANTAS

HARVESTING TOOLS AND MACHINES

C-KAT

CANTAS

TRACK TYPE HARVESTING MACHINE

WHEEL TYPE HARVESTING MACHINE

MPOB

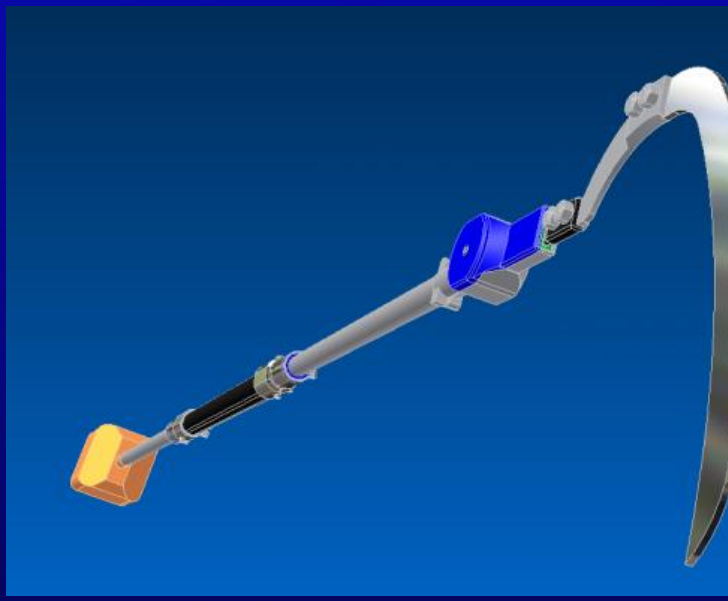
Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

Harvesting – Motorised cutter

- Mechanical Harvesting tool
- Chisel for young palms – C-KAT
- Sickle for older palms – CANTAS
- Motorised cutter (Cantas) increased productivity from 1.5 tonnes/man-day to 2.8 tonnes/man-day

Innovation: Cantas Evo

High quality cutting head, adjustable sickle profile, high quality pole gripper clamp and carbon fibre pole



- Durable cutting head (more than 600 hrs with no major breakdown)
- Less vibration (1 m/s2)

- Lighter (15% lighter than other versions).
  - Cantas Evo @ 7.4kg against 8.5 – 9.0 kg for existing Cantas)

- Higher reach (8 meters)

More than 120 units Evo head being used by industry

Development of Mechanical harvester (Wheel type)

Korean company has produced the commercial prototype (tested at Ldg Chembong, NS).

- New turntable system to improve the reach of the cutter
- Camera system to assist the operator harvesting more than 10 m .
- Traveling speed of the machine is 15km/hr as compared to only 5 km/hr with prime mover with track system.
- require camera system to assist the operator to aim the exact cutting point during the harvesting.

LOOSE FRUIT COLLECTION

LFC Mark I

LFC Mark III

LFC Mark II

Roller Picker

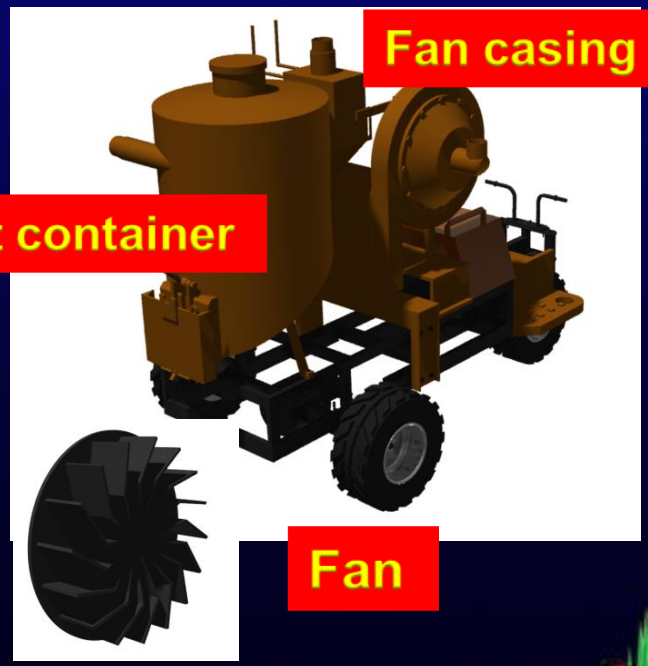
MPOB

Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

Loose fruit collecting machine

- Portion of debris in the loose fruits chamber was found to be in the region of 20-30 %.
- Minor modifications to improve the machine (i.e. reposition of the suction inlet, gear-fan shifting mechanism etc.)
- loose fruits are sucked quickly, reducing back pain of worker
- increases worker's productivity

Evaluated at Kuala Muda Estate, Kedah from Dec 2015 till March 2016



LOOSE FRUITS SEPARATING MACHINE

SEPARATION

CLEAN FRUITS

MPOB

Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

Transportation of FFB

Palm

↓

Platform

↓

Ramp

↓

Mill

- From palms to platforms
  - manual, wheel-barrow, bicycles, buffaloes, motorcycle-trailer, mini tractors, etc.
- From platforms to ramp by tractors on the same day
- From ramp to mill by lorries either on the same day or the following day

Tractor and grabber used by plantations

Motorcycle-trailer used by smallholders

IN-FIELD FFB EVACUATION MACHINES

Six Wheeler with Grabber

Crabbie

Beluga

Hydro-Porter

IN-FIELD FFB EVACUATION MACHINES

Powered Wheel Barrow	Motorcycle trailer	Otowey	Halftrack
			

IN-FIELD FFB EVACUATION MACHINES

Grabber

Rhyno

Compact Transporter

Articulated Tractor

Track Type Transporter for Oil Palm Field Activities in Peat Areas

- Single chassis, compact and robust
- Efficient weight distribution ratio,
  - least ground pressure
- For infield collection on peat and soft conditions
- For fertilizer application & weed control

BELUGA

MPOB

Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

Hydra-Porter - hydraulically driven FFB transporter

The wheel is individually powered by hydraulic motor

- LGP tyres to protect the ground and minimise ground disturbance
- Grabber system assists operator for loading FFB
- Traveling speed is 15 km/hr.
- Evacuates 18-25 tonnes FFB a day.
- FFB grabber and scissors lift, compatible with hook-lift and bin system.

Currently undergoing field trial at Bukit Bujang Estate, Segamat

CROP CARE & FIELD MAINTENANCE

CT-SPRAY

TRUNK INJECTOR APPARATUS

SPRAYER FOR YOUNG PALM

TRACTOR MOUNTED TIA

CROP CARE & FIELD MAINTENANCE

The use of soil stabilizer for estate road construction



Typical views on road condition after monsoon season

CROP CARE & FIELD MAINTENANCE

IMPORTING QUALITY SOIL

PLOUGHING USING ROTOVATOR

COMPACTING

FINISHING / COMPLETED TREATED ROAD

WATERING

BROADCASTING PRE MIX CEMENT & CHEMICAL

ROTOVATING TO THOROUGHLY MIX SOIL WITH PRE MIX CEMENT & CHEMICAL

MPOB

Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board

CROP CARE & FIELD MAINTENANCE

Road before treatment

After treatment - June 2013

Road at present – May 2016

CONCLUSION

New Innovations and technologies need to be continuously developed and field tested for the sustainability of the oil palm industry.

These include agronomic and pest management practices which reduces chemical use, enhances soil fertility and biocontrol agents for the long term control of pests and diseases.

Mechanisation technologies requires full support from the management for effective implementation in the field.

Thank you

MPOB

Lembaga Minyak Sawit Malaysia ● Malaysian Palm Oil Board