Workshop of MPOB-SOPPOA 2016

Sibu, Sarawak.

10th March 2016

Fertilizer Recommendation and Best Management of Oil Palm on Peat Soil

Hasnol Othman

Agronomy & Geospatial Unit
Malaysian Palm Oil Board (MPOB)

Research of Oil Palm Cultivation on Peat Soil
(Carried out by Agronomy & Geospatial Unit, MPOB)

Number of Research Project

Location	Completed	On-going	Total
Peninsular	6	1	7
Sarawak	6	6	12
Total	12	7	17

Completed Research

Land preparation & oil palm planting	Fertilizer management	Soil & water management	Palm leaning management
Soil compaction	Macro nutrients requirement	Cover crop – *Mucuna bracteata*	Unidirectional leaning
Planting density	Micro nutrients requirement	Drainage system	Planting technique
Planting technique	Soil conditioner - Zeolite	Optimum ground water table	
Planting materials	Bunch ash		
	Liming		

3 Focus On-going Research Projects
(Based on current issues)

1. Low / poor Fruit Set Formation	**Collaborator** Tabung Haji (TH) Plantation	**Location** Pusa, Betong, Sarawak.
2. Premature Frond Desiccation	**Collaborator** Tradewinds Plantation	**Location** Sibu, Sarawak.
3. Oil palm performance on Padang Paya & Padang Kerumtun Peat	**Collaborator** Sarawak Oil Palm Bhd (SOPB)	**Location** Miri, Sarawak.

Study on Low OER / Poor Fruit Set Formation

- Research conducted in Sarawak showed that fruit set formation was low on peat soil which **less than 50%** (Hasnol *et al.*, 2004) .
- Compared to normal fruit set ranging **60 – 80%** (Basri and Norman, 2000).

Scope of Syudy

1. **Role of boron in pollen viability and fruit set formation of oil palm on peat.**
2. **Effect of herbicides usage on pollen viability and female inflorescences fertility.**
3. **Effect of flower sex ratio and weather on fruit set formation.**

Study on Low OER / Poor Fruit Set Formation

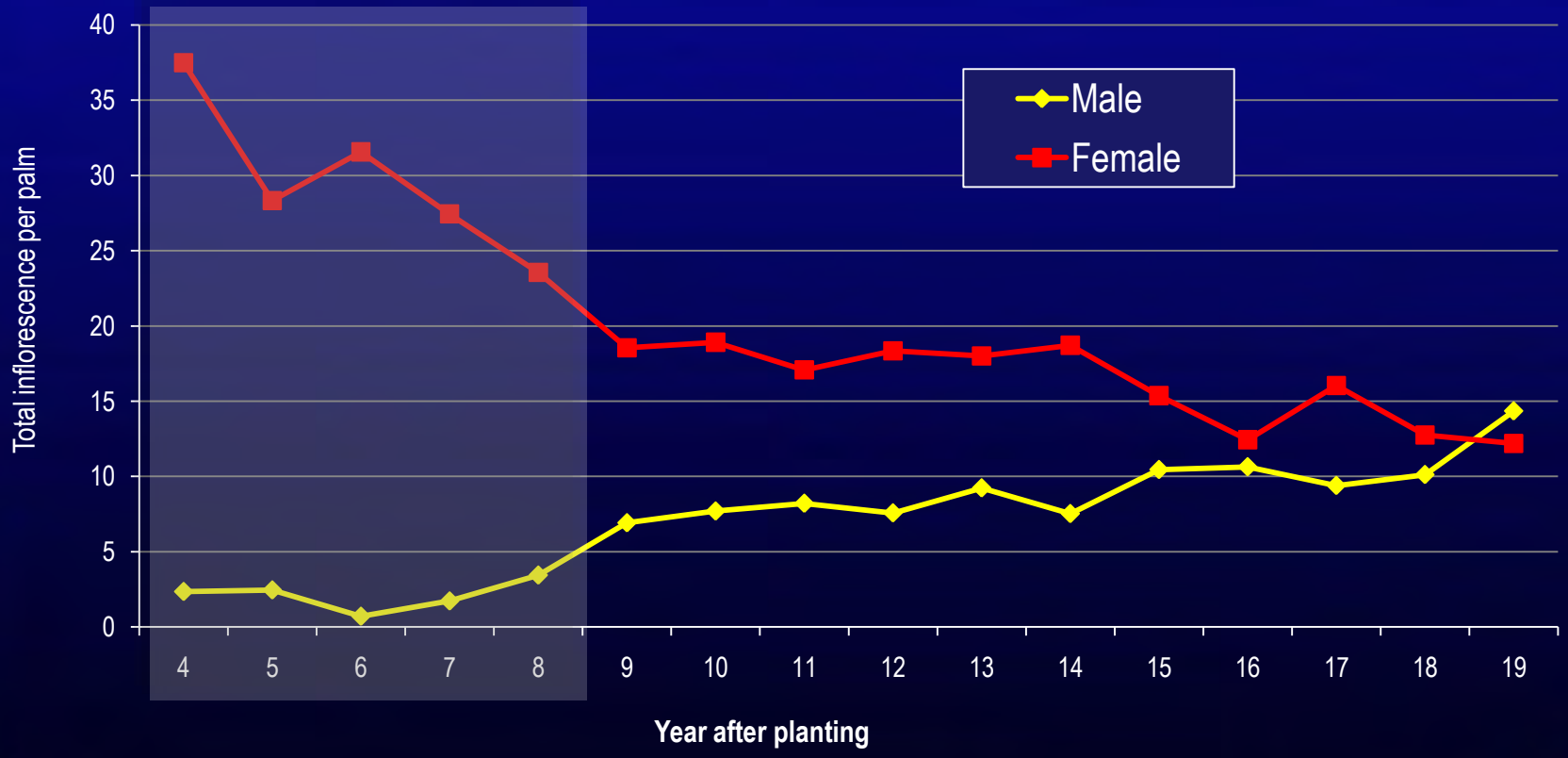
Effect of Planting Density on Yield Component and Fruit Set of Oil Palm on Peat at MPOB Research Station Sessang, Sarawak

Density (palms/ha)	Average of 6 Years Harvesting		Fruit Set (%)
	Bunch Production (no/palm/year)	Bunch Weight (kg)	
120	15.47 a	12.00 a	47.7 a
160	13.52 b	11.08 b	46.9 a
200	11.07 c	10.97 b	48.7 a
Overall mean	13.36	11.35	47.8
LSD 0.05	0.75	0.35	3.02

Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

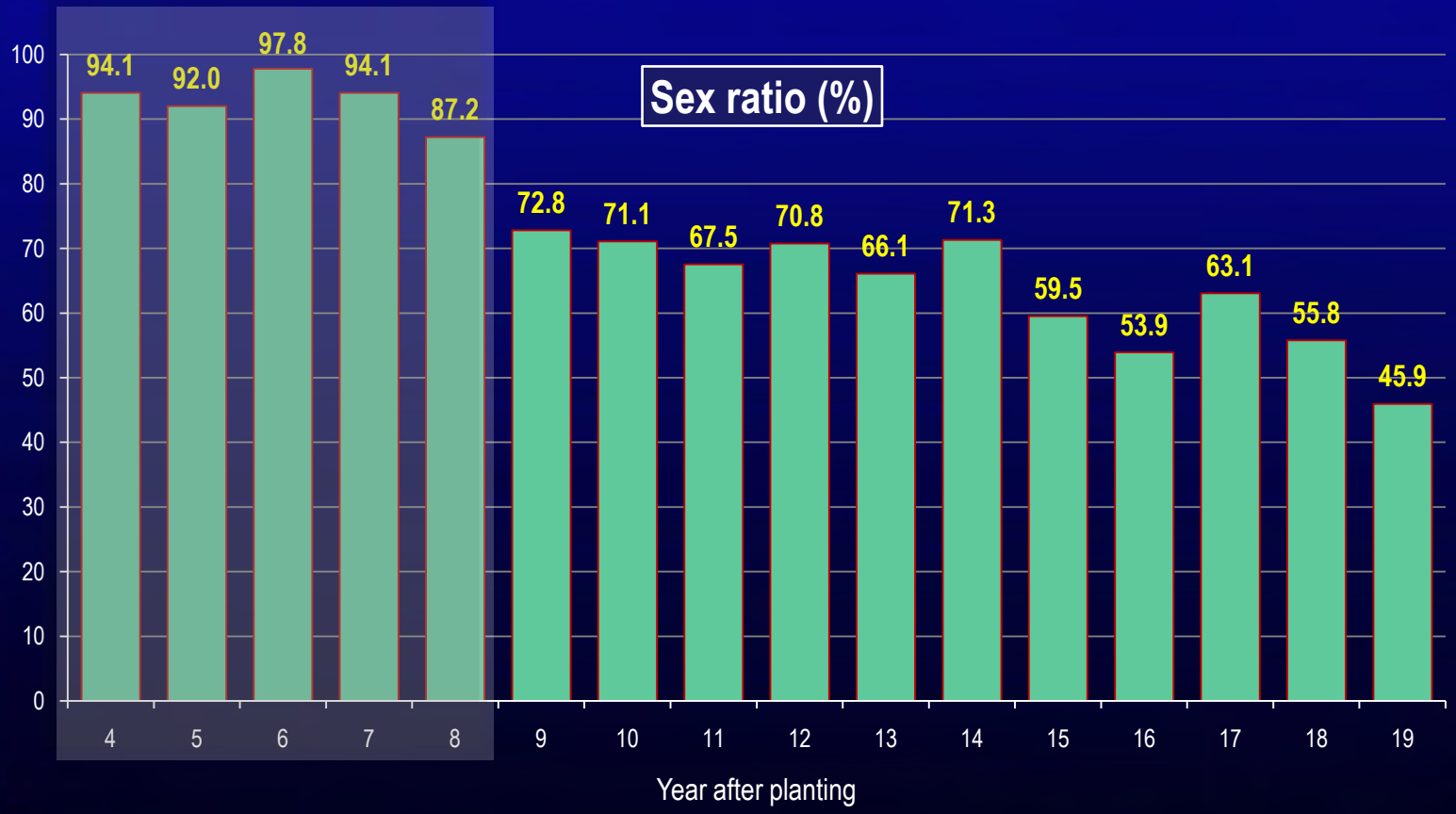
Study on Low OER / Poor Fruit Set Formation

Inflorescence Production of Oil Palm on Peat at MPOB Research Station Teluk Intan, Perak.



Study on Low OER / Poor Fruit Set Formation

Inflorescence Production of Oil Palm on Peat at MPOB Research Station Teluk Intan, Perak.



Study on Premature Frond Desiccation

Felcra Plantation, Mukah,Sarawak

Selezu Plantation, Bintulu, Sarawak

Taniku Plantation, Miri, Sarawak

- Reported in mature palms after 8 to 10 years oil palm planting and several cases reported occurred at early-mature palms stages.
- it is required to investigate the trigger and frond desiccated as these have vital impact on oil palm performance.

Investigation on premature frond desiccation in oil palm planted on peat soil in Sarawak

Part: 1

To explore and investigate the factor affecting frond desiccation .

Part 2:

To set up field trial with treatments that can reduce or overcome the incidence of frond desiccation.

Study on Yield Limiting Factors of Oil Palm Planting on Padang Paya & Padang Kerumtun Peat

Objectives

- To study the yield limiting factors of oil palm planting on Padang Paya & Padang Kerumtun peat.
- To determine NPK fertilizer requirement and suitable fertilizer type.
- To establishment site yield potential (SYP) of oil palm on Padang Paya & Padang Kerumtun peat.

Expected Benefits

- Establishment of yield potential and understanding of site-specific yield limiting factors;
- Recommendation of best management practice in relation to the fertilizer and water management of oil palm on Padang Paya & Padang Kerumtun peat

List of Research Project

A. Peninsular

No.	Project Title	Researcher	Duration	Location	Status
1	Oil palm planting density on moderate deep peat	Mohd Tayeb Dolmat	1982 – 1992 (10 years)	Mini Estate RISDA Pontian, Johor.	Completed
2	Planting density and NPK fertilizer trial on deep peat.	Mohd Tayeb Dolmat	1985 - 2005 (20 years)	MPOB Research Station Teluk Intan.	Completed
3	Land preparation and PK fertilizer on peat	Mohd Tayeb Dolmat	1985 - 2005 (20 years)	MPOB Research Station Teluk Intan.	Completed
4	Micronutrient nutrition of oil palm on peat.	Mohd Tayeb Dolmat	1985 - 2005 (20 years)	MPOB Research Station Teluk Intan.	Completed
5	Evaluation of MPOB's fertilizer and leaching study on peat soil.	Ahmad Tarmizi Mohamed	2005 - 2012 (7 years)	MPOB Research Station Teluk Intan.	Completed
6	Using zeolite as soil conditioner for oil palm cultivation on peat soil.	Hasnol Othman	2005 - 2012 (7 years)	MPOB Research Station Teluk Intan.	Completed
7	Effect of legume cover crops for oil palm on peat.	Hasnol Othman	2006 – 2016 (10 years)	MPOB Research Station Teluk Intan.	On-going

B. Sarawak

No.	Project Title	Researcher	Duration	Location	Status
1	Planting density and NPK fertilizer trial on shallow peat.	Mohd Tayeb Dolmat / Hasnol Othman	1994-2012 (18 years)	MPOB Research Station Sessang.	Completed
2	Potassium nutrition of mature oil palm on deep peat.	Mohd Tayeb Dolmat / Hasnol Othman	1999 -2006 (7 years)	MPOB Research Station Sessang.	Completed
3	Land preparation, planting technique and planting material trial of oil palm on deep peat.	Mohd Tayeb / Hasnol Othman	1996-2012 (16 years)	MPOB Research Station Sessang.	Completed
4	Fertilizer requirement and performance of oil palm In relation to field drain Intensity	Mohd Tayeb Dolmat / Hasnol Othman	1997-2007 (10 years)	MPOB Research Station Sessang.	Completed
5	Nitrogen requirement In relation to legume establishment and natural cover crops.	Mohd Tayeb Dolmat / Hasnol Othman	1997-2007 (10 years)	MPOB Research Station Sessang.	Completed
6	Unidirectional leaning through mechanical force of oil palm on deep peat	Hasnol Othman	2000-2015 (15 years)	MPOB Research Station Sessang.	Completed

B. Sarawak

No.	Project Title	Researcher	Duration	Location	Status
7	Nutrient cycling and residue management for oil palm replanted on peat soil.	Hasnol Othman	2009 – 2019 (10 years)	MPOB Research Station Sessang.	On-going
8	Nutrients and carbon stock in ground cover vegetation on peat	Farawahida Mohd Darus	2009 – 2019 (10 years)	MPOB Research Station Sessang.	On-going
9	Oil palm yield potential and limiting factors of oil palm on peat under ex-Padang Paya Forest.	Farawahida Mohd Darus	2009 – 2019 (10 years)	Ladang Timbarat 5, Miri, Sarawak.	On-going
10	Nutrient cycling and residue management for oil palm replanted on peat soil.	Hasnol Othman	2009 – 2019 (10 years)	MPOB Research Station Sessang.	On-going
11	Role of boron in pollen viability and fruit set formation of oil palm on peat.	Nur Zuhaili	2015-2020 (5 years)	TH Plantation Pusa, Betong.	On-going
12	Investigation on premature frond desiccation in oil palm on peat soil .	Farawahida Mohd Darus	2015-2020 (5 years)	Tradewind Sibu.	On-going

Research of Oil Palm Cultivation on Peat Soil
(Carried out by Agronomy & Geospatial Unit, MPOB)

Number of Research Output

TOT	Seminar proceeding	Journal / bulletin	Book chapter / manual
8	>16	5	5

LIST OF RESEARCH OUTPUTS

A. MPOB New Technology (TOT) - 8

No.	TT No.	Title	Year	Researcher
1	129	High oil palm planting density on peat.	2002	**Mohd Tayeb Dolmat**
2	254	Bunch ash: An efficient and cost-effective K fertilizer sources for mature oil palm on peat under high rainfall enviroment.	2005	**Hasnol Othman**
3	345	Uni-Slant: Unidirectional slanting-hole planting technique for oil palm on deep peat.	2007	**Hasnol Othman**
4	417	Technique for mechanically forced unidirectional leaning of oil palm on peat.	2009	**Hasnol Othman**
5	472	Best management practices for oil palm planting on peat: Optimum groundwater table.	2010	**Hasnol Othman**
6	473	Mapping of oil palm cultivation on peatland in Malaysia	2010	**Wahid Omar**
7	501	Best management practices for oil palm cultivation on peat: *Mucuna bracteata* as ground cover crop.	2012	**Hasnol Othman**
8	528	Best Management Practice for Oil Palm Cultivation on Peat: Zeolite as Soil Conditioner.	2013	**Hasnol Othman**

B. Proceeding - 16

No.	Title	Proceeding	Year	Researcher
1	Recent progress on research and development on peat for oil palm.	1996 Seminar on Prospect of Oil Palm Planting on Peat in Sarawak.	1996	Mohd Tayeb Dolmat
2	Experience on peat development for oil palm planting in PORIM peat research station in Sessang, Sarawak.	1996 Seminar on Prospect of Oil Palm Planting on Peat in Sarawak.	1996	Zulkifli Mohd Daud
3	Relation of fertilizer nutrients to *Ganoderma*.	1999 PORIM International Palm Oil Congress.	1999	Mohd Tayeb Dolmat
4	Development and management of oil palm on peatland an update	Workshop on Working Towards Integrated Peatland Management for Sustainable Development. Kuching, Sarawak.	1999	Mohd Tayeb Dolmat
5	Oil palm planting on peat – progress and future direction in research And development and commercial venture.	Seminar on Elevating National Oil Palm Productivity and Recent Progress in The Management of Peat and *Ganoderma*.	2002	Mohd Tayeb Dolmat

B. Proceeding

No.	Title	Proceeding	Year	Researcher
6	High oil palm planting density on deep peat.	Seminar on Elevating National Oil Palm Productivity and Recent Progress in The Management of Peat and *Ganoderma.*	2002	Mohd Tayeb Dolmat
7	Effects of various sources of potassium fertilizer application on oil palm planted on peat in Sarawak	International Palm Oil Congress – PIPOC 2005	2005	Hasnol Othman
8	Performance of oil palm on deep peat in relation to soil compaction and planting techniques.	Malaysian Soil Science Conference - SOILS 2007	2007	Hasnol Othman
9	Best management practice on peat: water management in relation to peat subsidence and estimation of Co2 emission in Sessang, Sarawak	International Palm Oil Congress - PIPOC 2009	2009	Ahmad Tarmizi Mohamed
10	Best management practices for oil palm cultivation on peat	Workshop on SOP for Oil Palm Cultivation on Peat	2010	Hasnol Othman

B. Proceeding

No.	Title	Proceeding	Year	Researcher
11	Amalan agronomi terbaik bagi penanaman sawit di tanah gambut: pengurusan air yang optimum	Persidangan Kebangsaan Pekebun Kecil Sawit.	2010	Hasnol Othman
12	The effect of P fertilizer on performance of oil palm on peat in Sarawak.	SOILS 2011 Conference - Soil Fertility and Plantation Productivity.	2011	Farawahida Md Darus
13	The effect of liming on performance of oil palm on peat in Sarawak.	SOILS 2011 Conference - Soil Fertility and Plantation Productivity	2011	Hasnol Othman
14	Amalan pengurusan terbaik bagi penanaman sawit di tanah gambut.	Bangkel Kajian Pelepasan Gas Rumah Hijau dan Pengurusan Tanah Gambut.	2012	Hasnol Othman
15	*Mucuna bracteata*: Tanaman kekacang penutup bumi terbaik di tanah gambut.	Persidangan Kebangsaan Pekebun Kecil Sawit 2012	2012	Hasnol Othman
16	Soil Respiration from Oil Palm Cultivated on Replanted Peat Area in Teluk Intan, Perak	UMT 11th International Annual Symposium on Sustainability Science and Management	2012	Nur Maisarah

C. Journal /Bulletin - 5

No.	Title	Journal/Bulletin	Year	Researcher
1	Development of peat soil for oil palm planting in Malaysia – Johore Barat Agricultural Project as a case study.	PORIM Bulletin	1982	Mohd Tayeb Dolmat
2	Recent progress on research and development on peat for oil palm.	PORIM Bulletin	1992	Mohd Tayeb Dolmat
3	Experience on peat development for oil palm planting in MPOB research station in Sessang, Sarawak.	Oil Palm Bulletin	2009	Hasnol Othman
4	Best management practices for oil palm cultivation on peat: ground water-table maintenance in relation to peat subsidence and estimation of co_2 emissions at Sessang, Sarawak	JOPR	2011	Hasnol Othman
5	Re-evaluation of Nutrients Requirements for Oil Palm Planting on Peat Soil.	The Planter	2014	Hasnol Othman

D. Book Chapter / Manual - 5

No.	Title	Book / Manual	Year	Researcher
1	Technologies for planting oil palm on peat	Booklet	2005	Mohd Tayeb Dolmat
2	Guidelines for the development of a standard operational procedure for oil palm cultivation on peatland.	MPOB Manual	2011	Mohd Hanif Harun
3	Refinement of technologies for oil palm cultivation on peatland in Malaysia	Book chapter – Further Advances in Oil Palm Research (2000-2010)	2011	Ahmad Tarmizi Mohamed
4	Soils of the Lower and Midle Baram River Basin Miri Division, Sarawak.	Book	2014	S Paramananthan Wahid Omar
5	Tropical Peat Ecosystem – The Frequently Asked Questuins	Booklet	2015	**Mohd Hanif Harun**

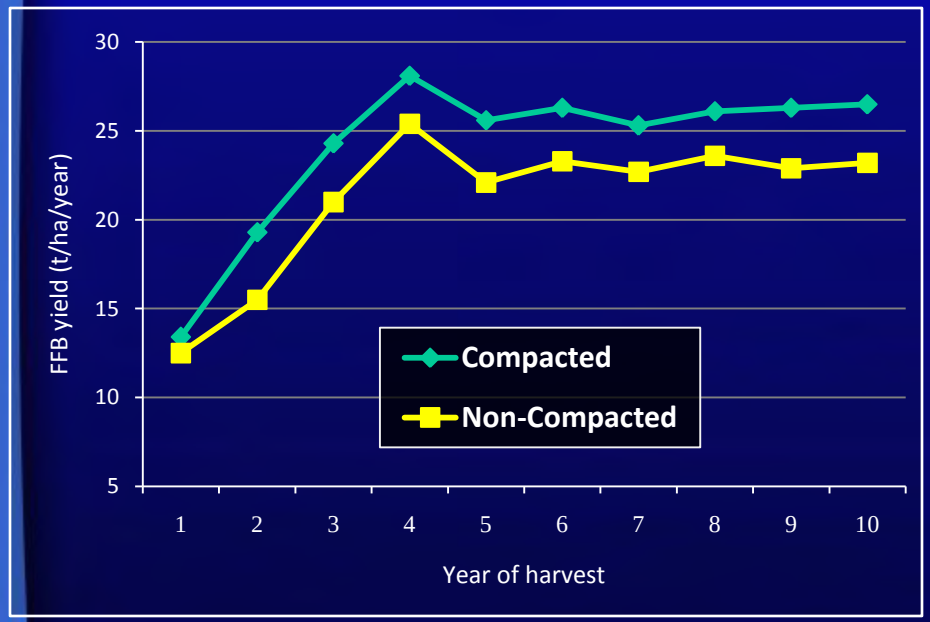
Best Management Practices (BMPs)

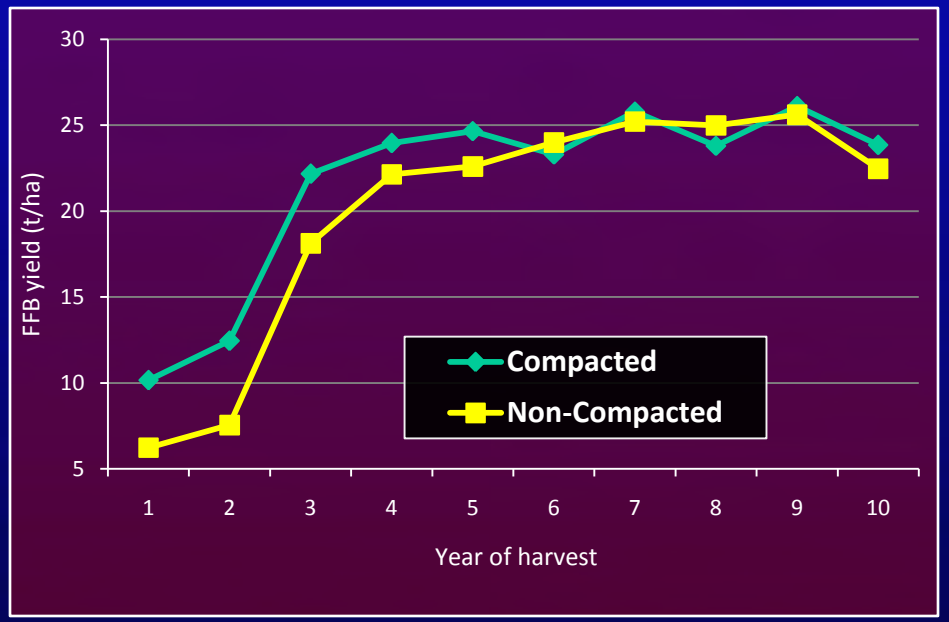
1. Soil Compaction
2. Planting Material
3. Planting Technique
4. Planting Density
5. Ground Cover Management
6. Ground Water Management
7. Palms Leaning Management
8. Fertilizer Management

1. Soil Compaction

1. **Commence**: 3 to 4 weeks after the field drains have been dug.
2. **Water table**: > 70 cm below ground surface.
3. **Method**: mechanical soil compaction using an excavator.
4. **Area compaction**: along planting rows and harvesting paths (minimum width of 9.5 m)
5. **Round of compaction** : two - four runs.
6. **Compaction quality indicator**:
   - ✓ Depth of compact: > 0.40m below the original surface level.
   - ✓ Soil bulk density: > 0.15 gcm^{-3}

1. Soil Compaction





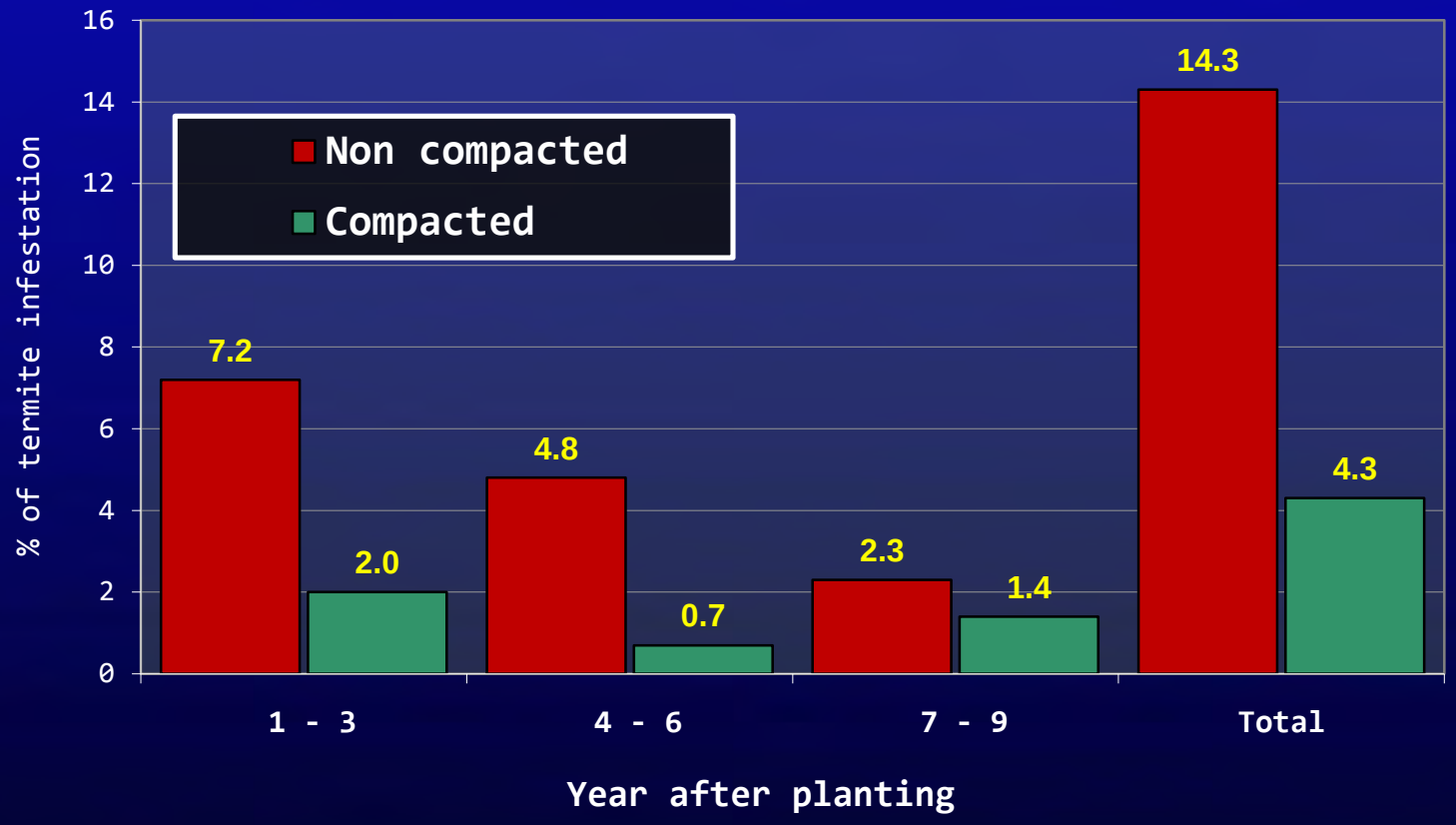
Effect of soil compaction on FFB yield of oil palm planting on deep peat at MPOB Research Station Teluk Intan, Perak

Effect of soil compaction on FFB yield of oil palm planting on deep peat at MPOB Research Station Sessang, Sarawak

Compacted peat

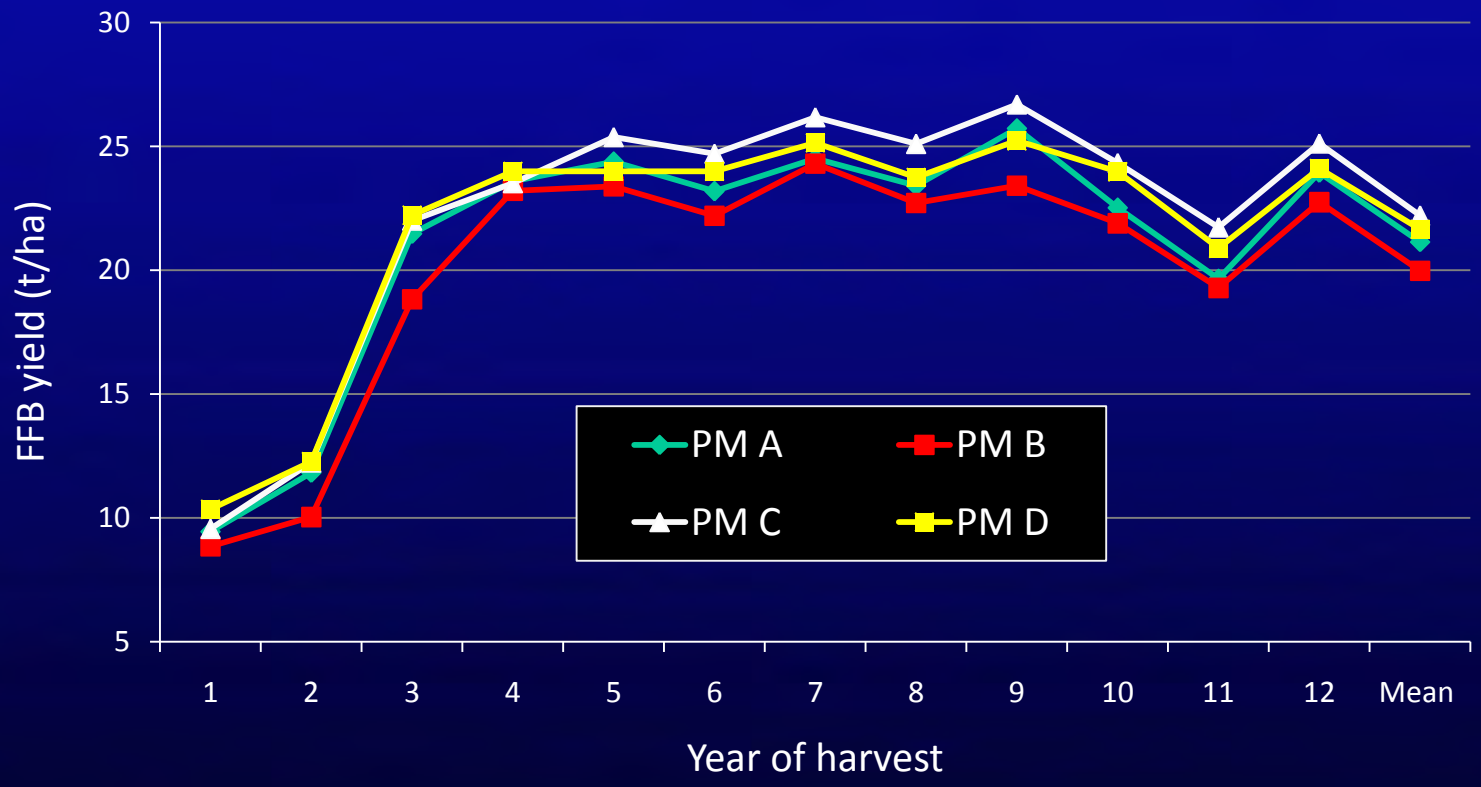
Non compacted peat

1. Soil Compaction



Distribution of termite infested palms on deep peat at MPOB Research Station Sessang, Sarawak

2. Planting Material



FFB yield profile of different commercial oil palm DxP planting on compacted deep peat at MPOB Research Station Sessang, Sarawak

3. Planting Density

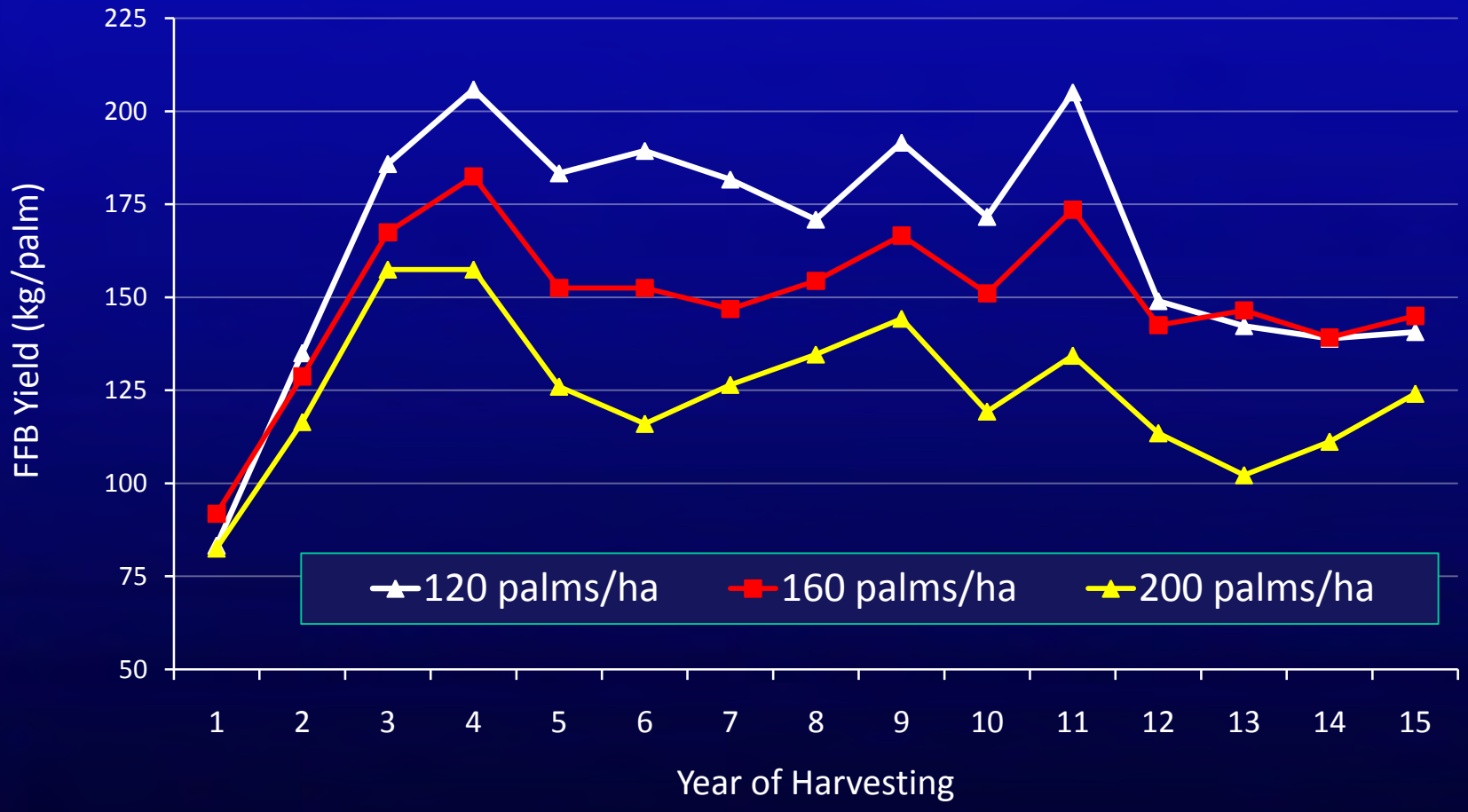
Peat depth	Condition	Palms/ha	Distance (m)	
			Inter palms	Inter rows
Shallow	❑ High rainfall ❑ Subsoils - clay	138	9.15	7.92
	❑ Law rainfall ❑ Subsoil - sandy	148	8.83	7.65
Moderate & deep	-	160	8.50	7.36

Effect of Planting Density on Yield Component and Fruit Set of Oil Palm Planting on Peat at MPOB Research Station Sessang, Sarawak

Density (palms/ha)	Average of 15 Years Harvesting		Fruit Set (%)
	Bunch number (no./palm/year)	Bunch weight (kg)	
120	12.90 a	12.79 b	47.7 a
160	11.30 b	13.23 a	46.9 a
200	9.75 c	12.76 b	48.7 a
Mean	11.32	12.93	47.8
LSD 0.05	0.28	0.25	3.02

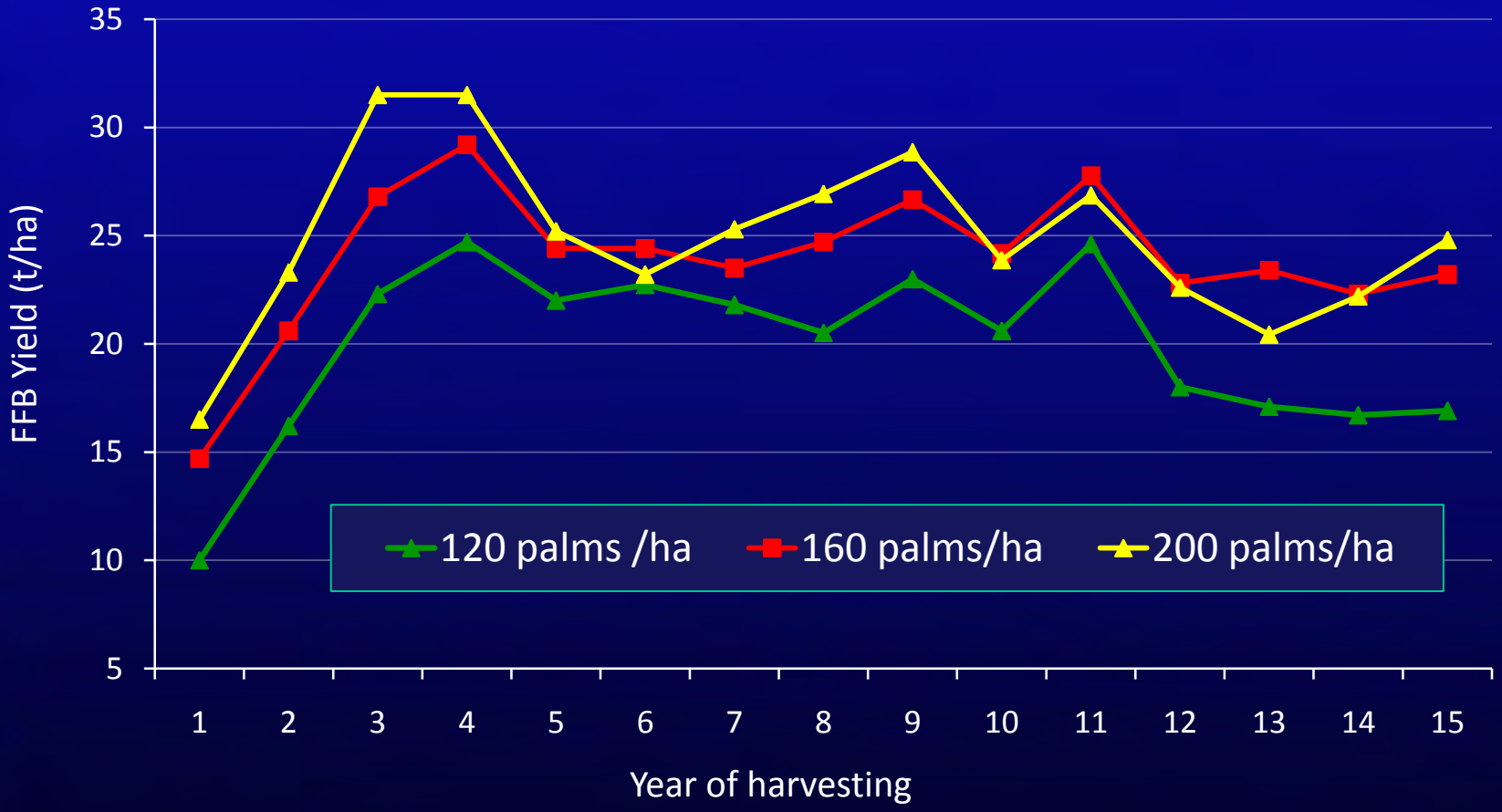
Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

3. Planting Density



Effect of planting density on FFB yield per palm basis of oil palm planting on peat at MPOB Research Station Sessang, Sarawak

3. Planting Density



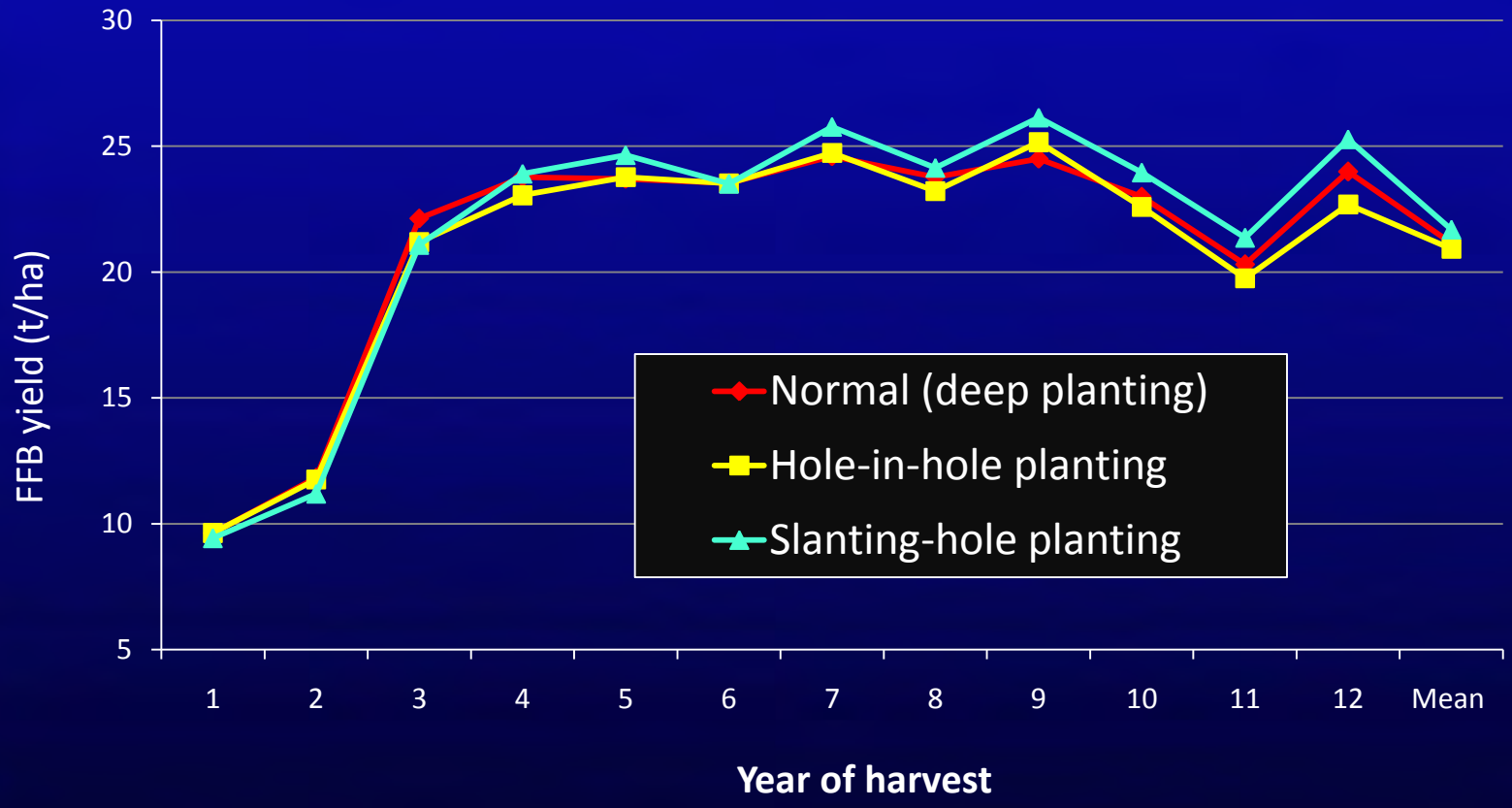
Effect of planting density on FFB yield per area basis of oil palm planting on peat at MPOB Research Station Sessang, Sarawak

4. Planting Technique

Peat depth	Soil compaction	Planting technique
Shallow	Yes	Hole-in-hole
moderate	Yes	Hole-in-hole
Deep	Yes	Normal hole/deep planting
	no	Hole-in-hole




4. Planting Technique



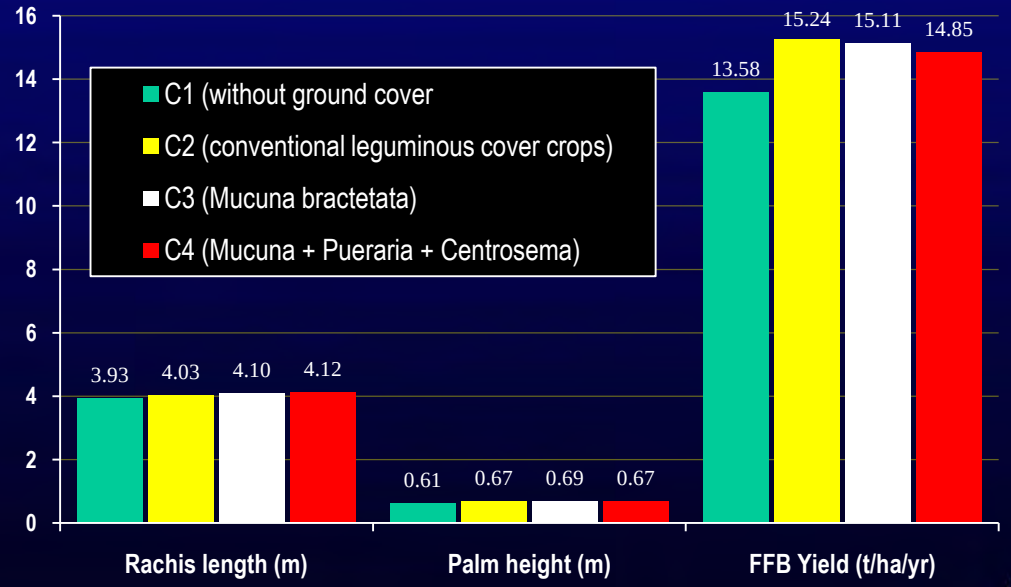
FFB yield profile of different planting technique of oil palm on compacted deep peat at MPOB Research Station Sessang, Sarawak

5. Ground Cover Management

Mucuna bracteata

- ✓ Improve palm's growth and yield.
- ✓ Soil moisture conservation.
- ✓ Weed management.
- ✓ Prevent irreversible peat drying.
- ✓ Reduce the risk of peat fire.

Natural covers: *Nephorolepis*



The effect of ground covers management on early oil palm performance

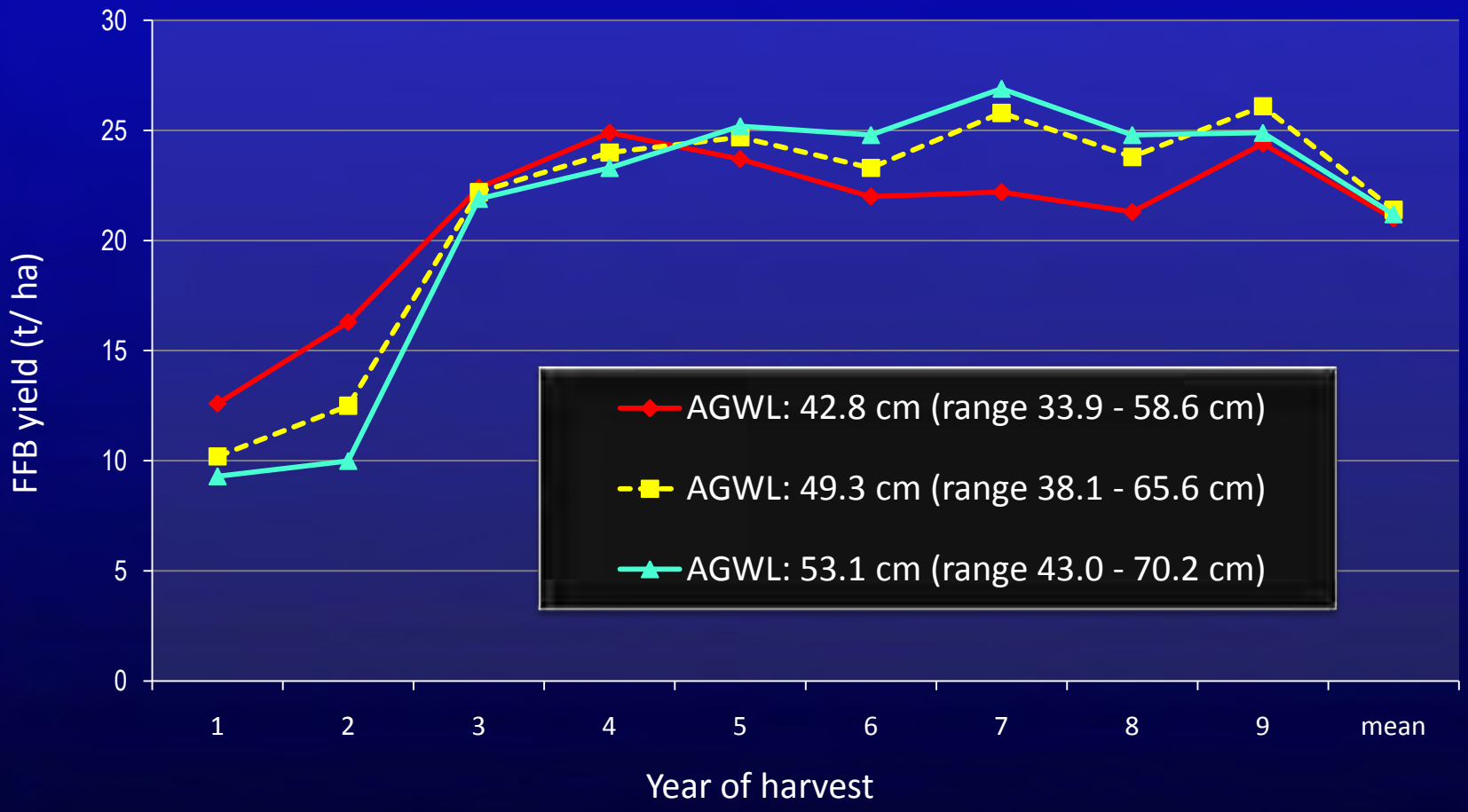
6. Ground Water Management

- To retain an optimum ground water table for superior palm growth and high yield.
- To drain out excess water and avoid prolonged flooding periods.
- To minimise excessive peat subsidence, thus, minimising CO_2 emission.
- To avoid irreversible drying of the peat surface.
- To minimise the risk of peat fires.

Optimum Groundwater Table

Development stage	Water level from ground surface (cm)	
	Groundwater table (in field)	Water level (at collection drain)
Immature (1-3 years old)	30 to 40	35 to 45
Young mature (4-7 years old)	35 to 45	45 to 55
Fully mature (> 8 years old)	40 to 50	50 to 60

6. Ground Water Management



FFB yield profile of oil palm on deep peat at different groundwater table depth at MPOB Research Station Sessang, Sarawak

7. Palms Leaning Management

Effect of palm leaning on FFB yield of oil palm on deep peat at MPOB Research Station Teluk Intan, Perak

Technique for Mechanically Forced Unidirectional Leaning of Oil Palm on Peat

- The young palms were forcibly pushed using an excavator to lean in one direction.
- And day after, the mechanically forced palms leaned progressively and unidirectional.

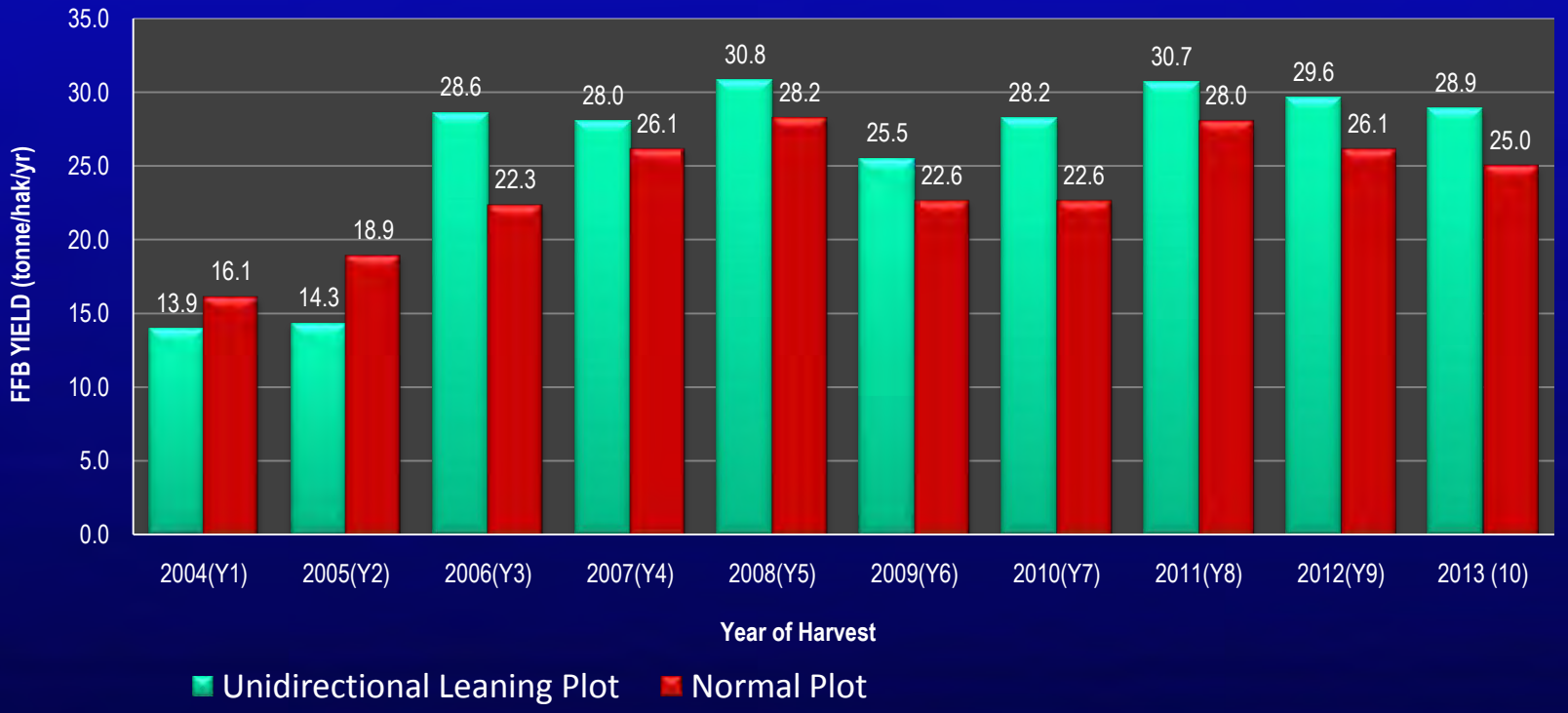
- ✓ Avoid incidence of severe leaning and palms uprooted.
- ✓ Improve efficiency of field operations especially harvesting works.




Work Schedule

	**Step 1:**	When the palms reached 30 months old, they were forcibly pushed using an excavator to lean at 45º 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.

7. Palms Leaning Management



Effect of unidirectional leaning of young palms by mechanical force on FFB yield

8. Fertilizer Management

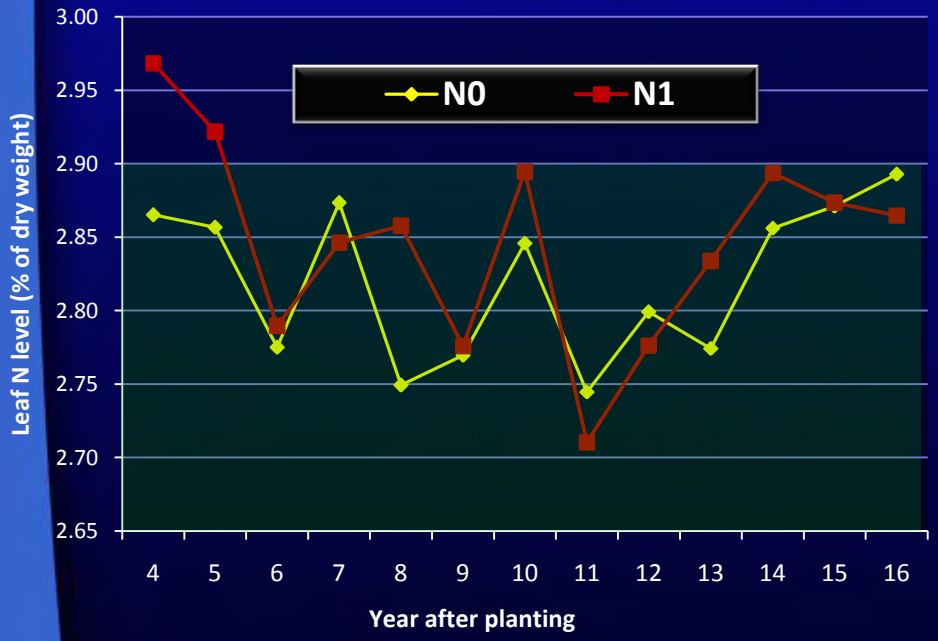
- Low soil bulk density – nutrients leaching
- Very acidic – low availability of micronutrients
- High C/N ratio - low availability of N
- Peat decomposition – release high N
- High organic matter – high availability of P
- High soil Mg – depress uptake of K
- Low soil fertility – K, Cu, Zn and B
- Low water retention – effected nutrients uptake

N Fertilizer Requirement

- The low or non-significant of N fertilizer treatment was due to a sufficient supply of natural N sources from peat mineralization.
- Sharif *et al*. (1986) had estimated that about 5.0 t N ha^{-1} was present in the top of peat.
- Excessively high N inputs will lead to high nitrous oxide and methane emissions (Melling, *et al,* 2006; Melling, *et al,* 2011).
- The optimum rate of N fertilizer application is less than 1.0 kg $palm^{-1}$ yr^{-1} of urea (0.5 to 0.6 kg).

Effect of N Fertilizer on Leaf N level of frond 17 (% of dry weight)

N0: unfertilized *N1: 1.0 kg palm^{-1} yr^{-1} of urea*



N rate	Year after planting			
	4th	5th	7th	8th
N0	2.72 a	2.76 b	2.76 a	2.68 a
N1	2.73 a	2.82 a	2.77 a	2.70 a
Mean	2.73	2.79	2.76	2.69
LSD $_{0.05}$	0.05	0.06	0.13	0.06

Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

MPOB Research Station Teluk Intan, Perak

MPOB Research Station Sessang, Sarawak

Effect of N Fertilizer on FFB Yield and Yield Components (6-year mean) of Oil Palm on Peat (MPOB Research Station Sessang, Sarawak)

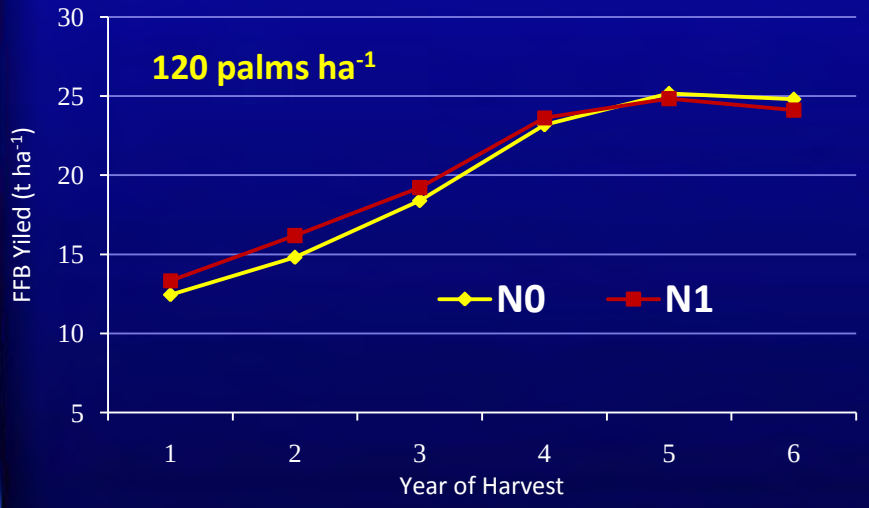
N rate	FFB yield (kg palm^{-1} yr^{-1})	Bunch production palm^{-1}yr^{-1}	Average bunch weight (kg)
N0	151.3 a	13.39 a	11.31 a
N1	153.3 a	13.33 a	11.39 a
Mean	152.3	13.35	11.35
LSD $_{0.05}$	7.54	0.61	0.28

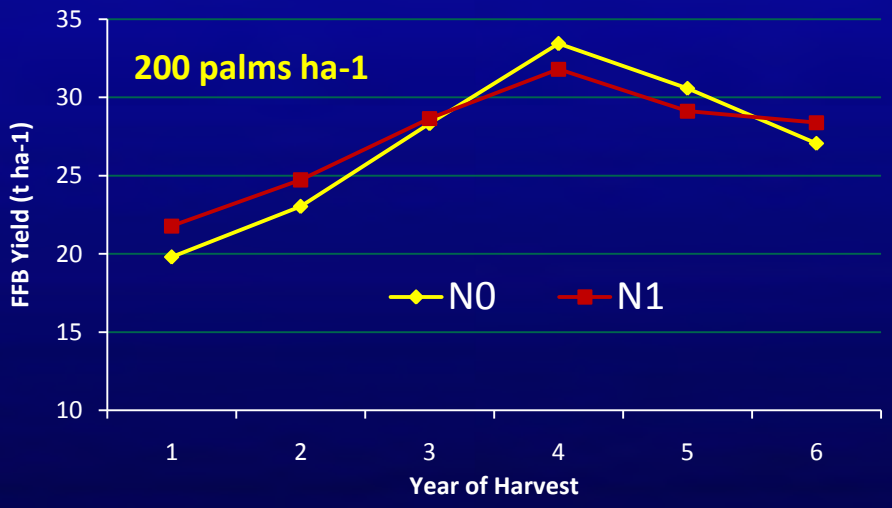
1.3% response

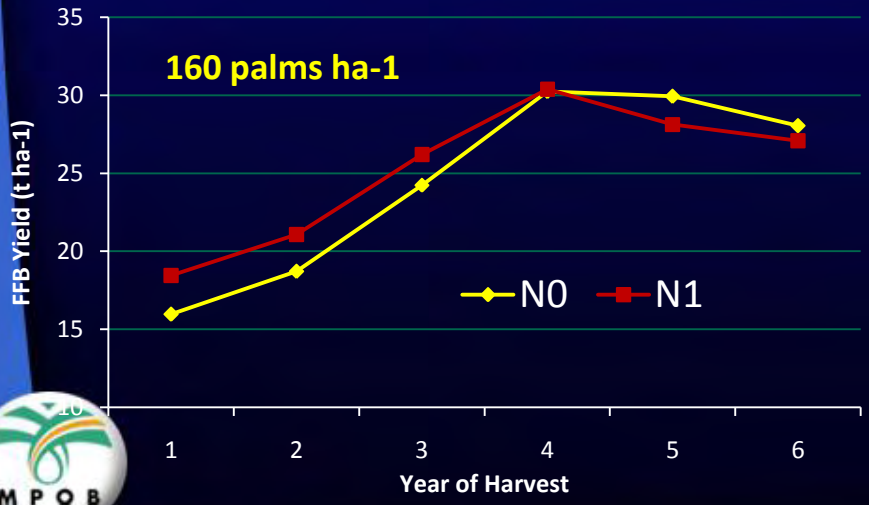
Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

N0: unfertilized *N1: 1.0 kg palm^{-1} yr^{-1} of urea*

Effect of N Fertilizer on FFB Yield of Oil Palm Planted on Deep Peat (MPOB Research Station Teluk Intan, Perak)







- Oil palm responses to N fertilizer only occurred in the early years.
- In later years, the addition of N fertilizer suppressed yield

N0: unfertilized N1: 1.0 kg palm^{-1} yr^{-1} of urea

Effect of N Fertilizer on FFB Yield (t ha^{-1}) of Oil Palm Planted on Second Generation Peat (MPOB Research Station Teluk Intan, Perak)

N rate	Year 1	Year 2	Year 3	Year 4	Year 5	Mean
N_0 (zero plot)	10.51 a	17.03 a	24.58 a	28.31 a	32.80 a	22.90 a
N_1 (half rate)	10.34 a	17.31 a	23.85 a	27.98 a	32.95 a	22.66 a
N_2 (normal rate)	11.04 a	18.01 a	24.15 a	27.40 a	32.23 a	22.42 a
mean	10.63	17.45	24.20 a	27.90	32.66	21.33
$LSD_{0.05}$	0.76	1.04	1.17	1.33	1.29	1.12

Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

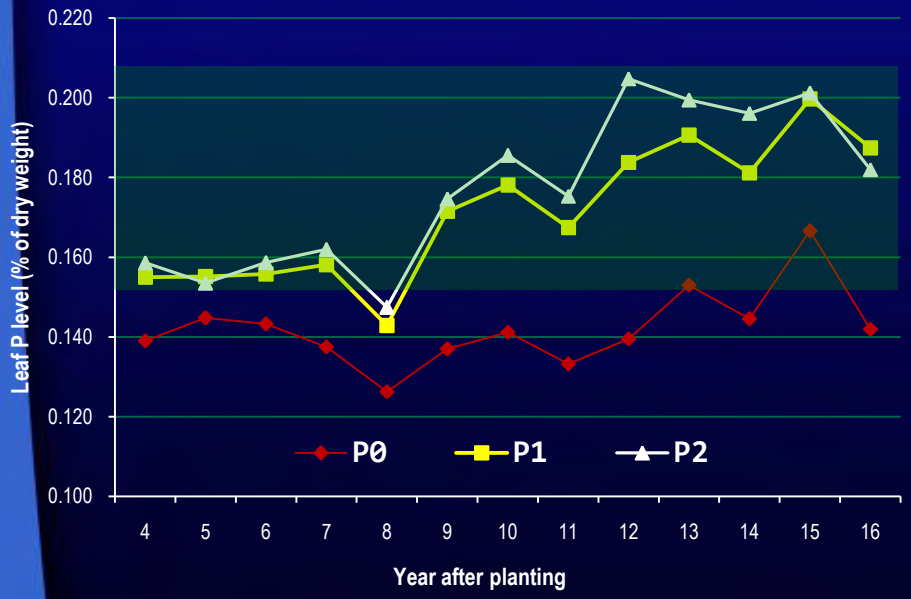
N0: unfertilized *N1: 0.5 kg $palm^{-1}$ yr^{-1} of urea* *N2: 1.0 kg $palm^{-1}$ yr^{-1} of urea*

P Fertilizer Requirement

- No significant response of oil palm to P fertilizer application (Gurmit *et al*, 1987; Gurmit, 1999).
- Research works on deep peat in North Sumatra province in Indonesia proposed that 0.5 kg phosphate rock palm^{-1} yr^{-1} should be sufficient to maintain optimum leaf P status (Manjit *et al*, 2004).
- Excessive P fertilizer application should be avoided to ensure lower *Ganoderma* basal stem rot incidence (Mohd Tayeb, 2002).
- The optimum rate of P fertilizer for oil palm on peat should not exceed 1.0 kg RP palm^{-1} yr^{-1}.

Effect of P Fertilizer on Leaf N level of frond 17 (% of dry weight)

MPOB Research Station Teluk Intan, Perak



MPOB Research Station Sessang, Sarawak

P Rate	Year after planting			
	4th	5th	7th	8th
P0	0.155 a	0.145 a	0.163 b	0.146 b
P1	0.159 a	0.146 a	0.164 b	0.156 a
P2	0.157 a	0.151 a	0.169 a	0.158 a
Mean	0.157	0.147	0.165	0.153
$LSD_{0.05}$	0.005	0.007	0.005	0.004

Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

Effect of P Fertilizer Application on FFB Yield (6-year mean) of Oil Palm on peat (MPOB Research Station Teluk Intan, Perak)

Treatment	FFB yield (kg palm^{-1} year^{-1})	Bunch production Palm^{-1} Year^{-1}	Average bunch weight (kg)
P0	144.7 b	12.95 b	11.11 b
P1	154.3 a	13.27 ab	11.56 a
P2	158.0 a	13.88 a	11.38 ab
mean	152.3	13.36	11.35
LSD $_{0.05}$	9.23	0.75	0.35

Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

K Fertilizer Requirement

- Fertilizer application in peat area in Sarawak becomes more critical due to the high leaching environment.
- Potassium was leached rapidly from the peat and a contributory factor to rapid K release was the low effective cation exchangeability capacity (CEC) of the peat (Malcolm *et al.*,1997).
- The optimum rate of K fertilizer for oil palm on peat recommended at 4.0 - 6.0 kg MOP palm^{-1} yr^{-1}.

Effect of K Fertilizer on Leaf N level of frond 17 (% of dry weight) of Oil Palm on Peat (MPOB Research Station Sessang, Sarawak)

K Level	Year After Planting			
	4th	5th	7th	8th
K1	0.816 a	0.720 b	0.860 a	0.840 b
K2	0.824 a	0.769 ab	0.905 a	0.956 a
K3	0.853 a	0.794 a	0.871 a	0.987 a
Mean	0.831	0.761	0.879	0.928
$LSD_{0.05}$	0.047	0.055	0.059	0.058

Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

Effect of K Fertilizer on FFB Yield and Yield Components (6-year mean) of Oil Palm on Peat (MPOB Research Station Sessang, Sarawak)

K rate	FFB yield (kg palm^{-1} yr^{-1})	Bunch production palm^{-1} yr^{-1}	Average bunch weight (kg)
K1	147.6 a	13.37 a	10.97 b
K2	155.0 a	13.48 a	11.42 a
K3	154.4 a	13.22 a	11.66 a
Mean	152.3	13.36	11.35
LSD $_{0.05}$	9.23	0.75	0.35

5% response

Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

Effect of K Fertilizer on FFB Yield of Oil Palm Planted on Peat (MPOB Research Station Teluk Intan, Perak)

Year of harvest	FFB (t ha^{-1} yr^{-1})			
	K0	K1	K2	K3
1	13.3	13.9	15.4	14.5
2	14.2	16.4	17.9	19.2
3	16.1	21.6	23.8	24.4
4	16.6	26.3	29.3	28.3
5	13.2	23.1	25.1	25.3
6	12.2	23.5	24.7	25.4
mean	**14.3**	**20.8**	**22.7**	**22.9**

45.5% response **9.1% response**

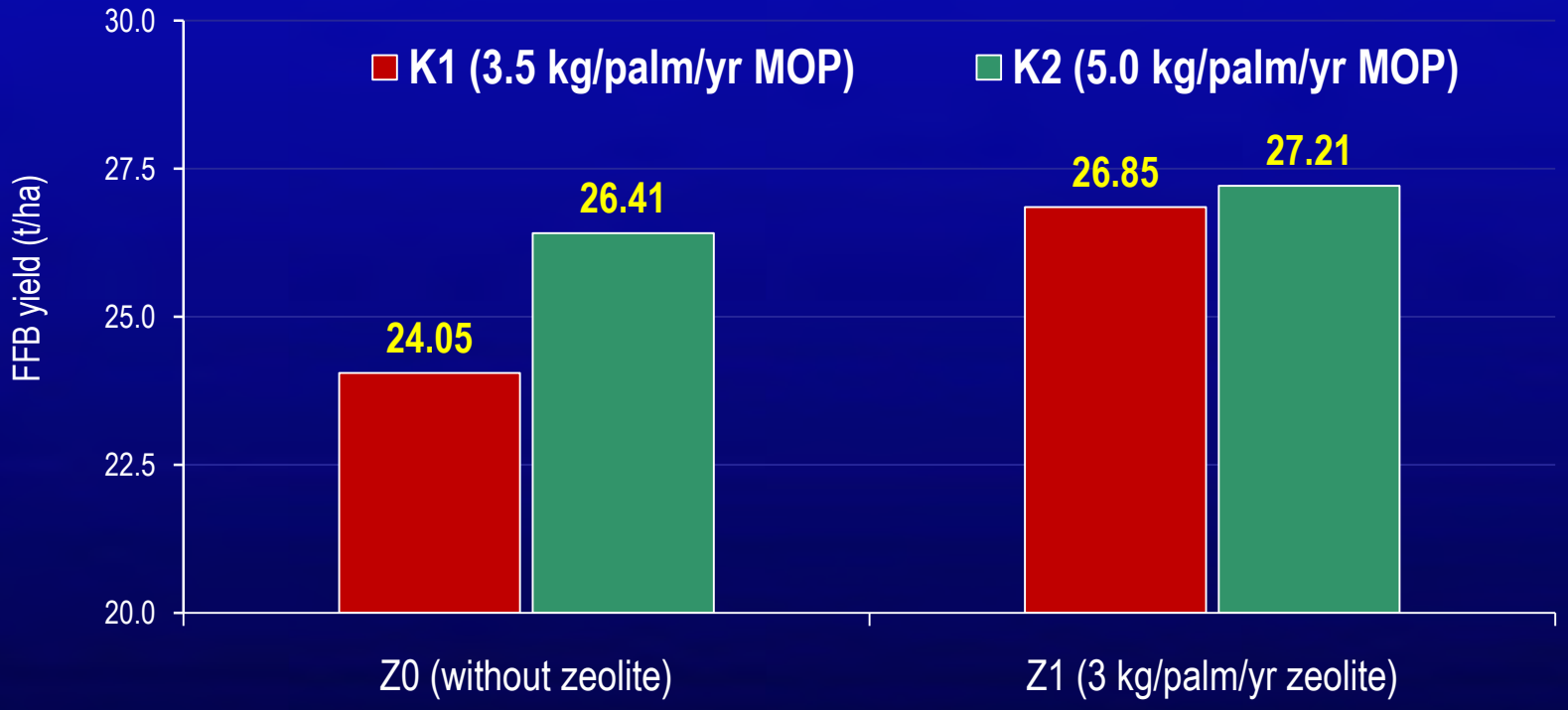
MPOB TT No. 254
Bunch Ash: An efficient and cost effective K fertilizer source for mature oil palm on peat under high rainfall environment.

- ✓ Strongly alkaline (pH=12) that help to improve the soil pH
- ✓ Increased FFB yield from compare with the equivalent quantity of K applied as MOP and SOP
- ✓ The FFB production cost was lower compared with the equivalent quantity of K applied as MOP and SOP

MPOB TT No. 528
Best Management Practices for Oil Palm Cultivation on Peat: Using Zeolite as Soil Conditioner

The combination application of 3.0 kg palm^{-1} year^{-1} zeolite and 3.5 kg palm^{-1} year^{-1} MOP is the agronomically and economically optimum input for oil palm on peat.

8. Fertilizer Management



Without zeolite application (Z0 plot) - the optimum K requirement was 5.0 kg MOP palm^{-1} year^{-1}

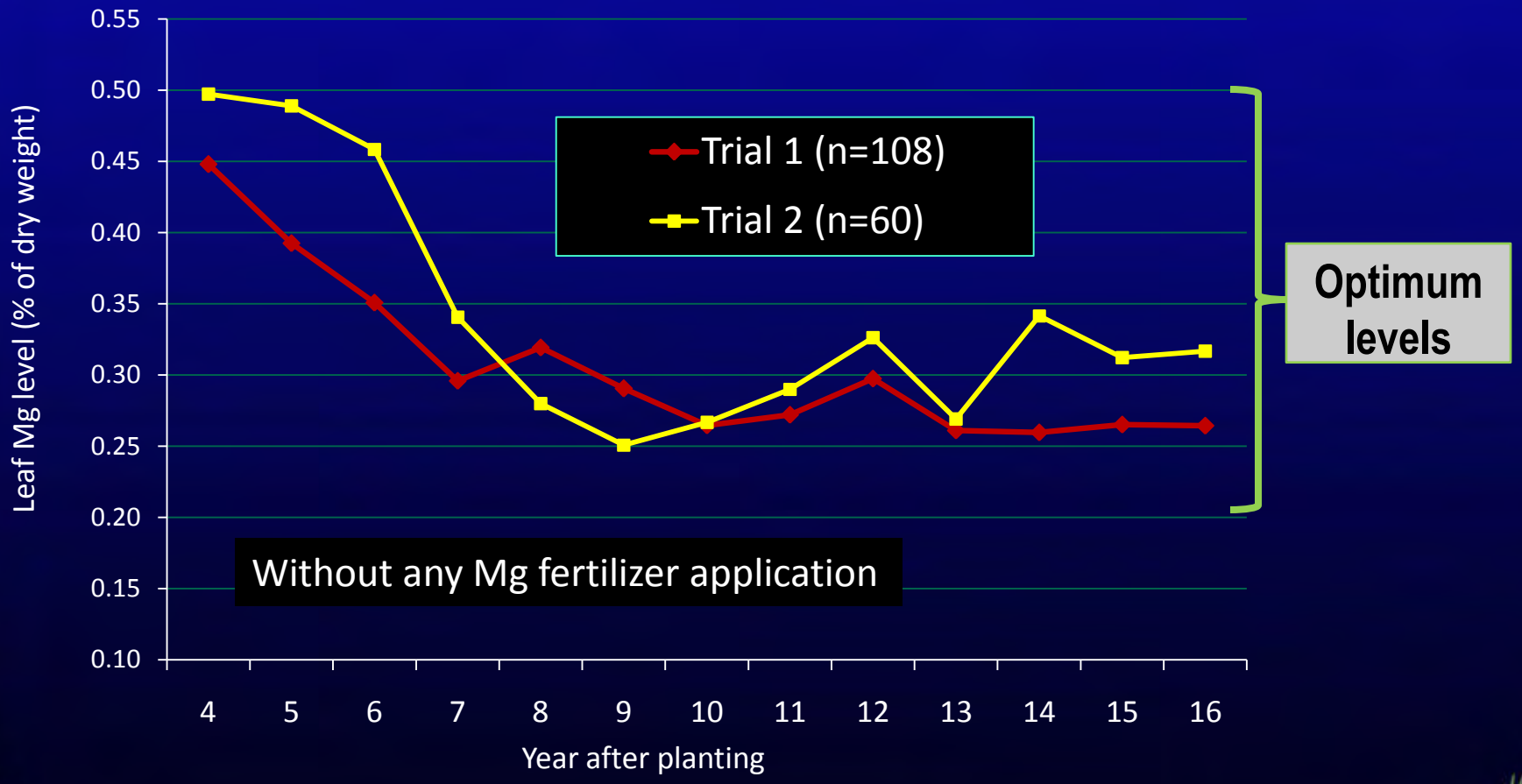
With zeolite application (Z1 plot) - the optimum K requirement was 3.5 kg MOP palm^{-1} year^{-1}

Zeolite application improve K fertilizer uptake efficiency

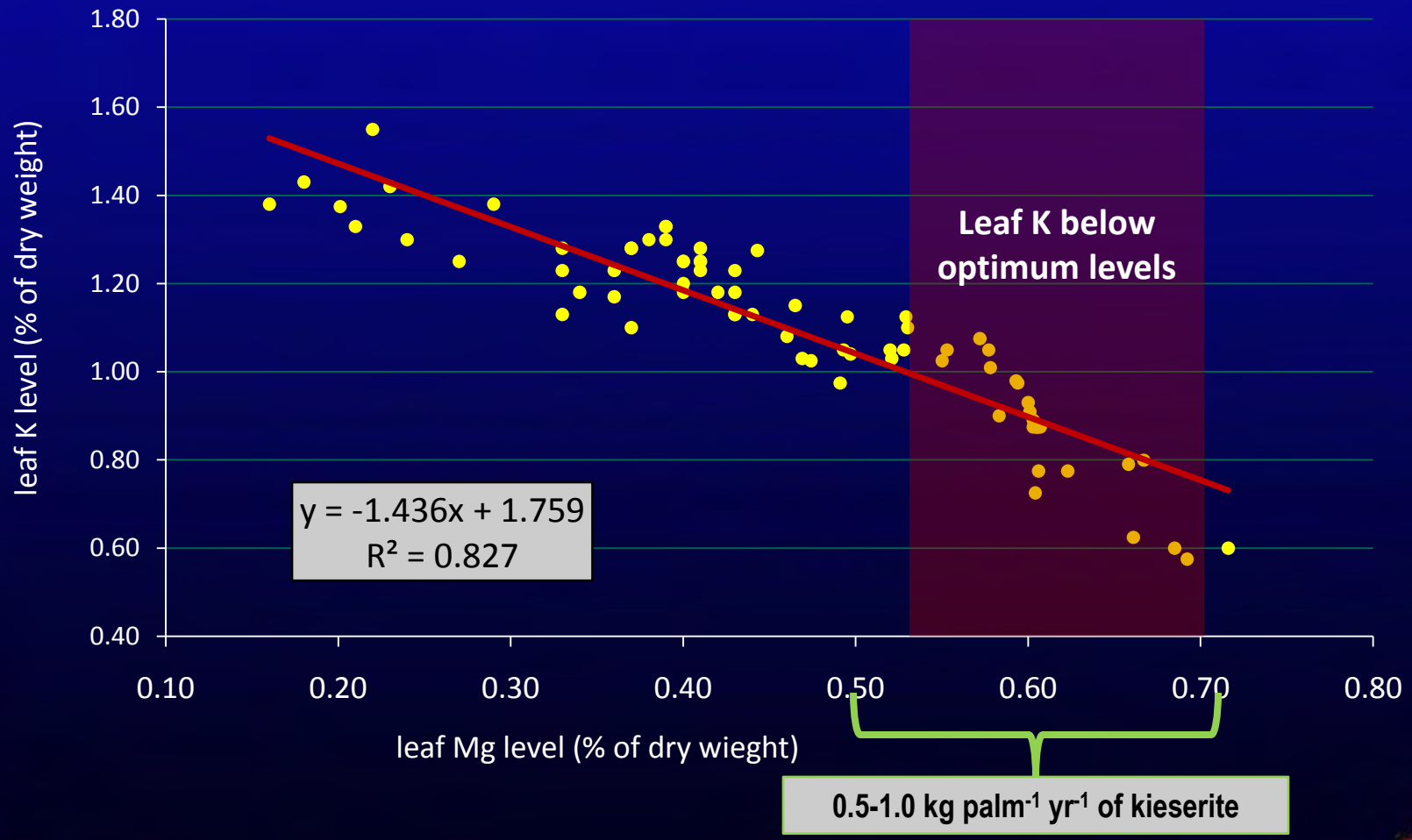
Mg Fertilizer Requirement

- There was adequate Mg in the peat to meet the palm's requirement (Gurmit *et al, 1*987; Jaman and Kueh,1996).
- Leaf Mg levels was significantly reduced by K fertilizer application however remained high even at the highest K rate of 7.0 kg MOP palm^{-1} yr^{--1} (Manjit *et al*.,2004).
- Excessive application of Mg fertilizer may induce K deficiency (antagonistic relationship).
- Mg fertilizer requirement should be base on leaf analysis results.

Mean of Leaf Mg Level of Oil Palm Planted on Peat (MPOB Research Station Teluk Intan, Perak)



Relationships Between Leaf K and Leaf Mg Levels Obtained from Leaf Nutrient Analysis of Oil Palm on Peat



Liming Requirement

Effect of Liming on FFB Yield, Leaf Nutrient levels and Soil pH of Oil Plan on Peat (MPOB Research Station Sessang, Sarawak)

Liming Rate	FFB Yield (kg year^{-1})	Leaf K (%)	Leaf Ca (%)	Soil pH
L0	144.9	0.976	0.561	3.84
L1	148.9	0.951	0.549	3.99
L2	**142.1**	**0.899**	**0.600**	**3.95**
Mean	145.3	0.942	0.570	3.23
LSD 0.05	9.67	0.051	0.034	0.23

Mean within the same column with the same letter are not significantly different at p=0.05 (Duncan's Test)

FFB yield: 7-year mean Leaf & soil analysis: 10 years after treatment

L0: Without liming
L1: 2.5 kg LSD/palm (only during planting)
L2: 4.5 kg LSD/palm during planting + 2.0 kg LSD/palm/year

Micro Nutrients Requirement

Nutrient	g/palm			
	Y1	Y2	Y3	Y4 & above
CuSO4	200	150 - 200	150 - 200	Based on foliar analysis result
ZnSO4	200	150 - 200	150 - 200	Based on foliar analysis result
Borate 48	-	150 - 200	-	150 – 200 (alternate year)
MnSO4	Not required			
FeSO4	Not required			

Micro Nutrients Requirement

CuSO4: 200g (Y1); 150g (Y2); 150g (Y3)

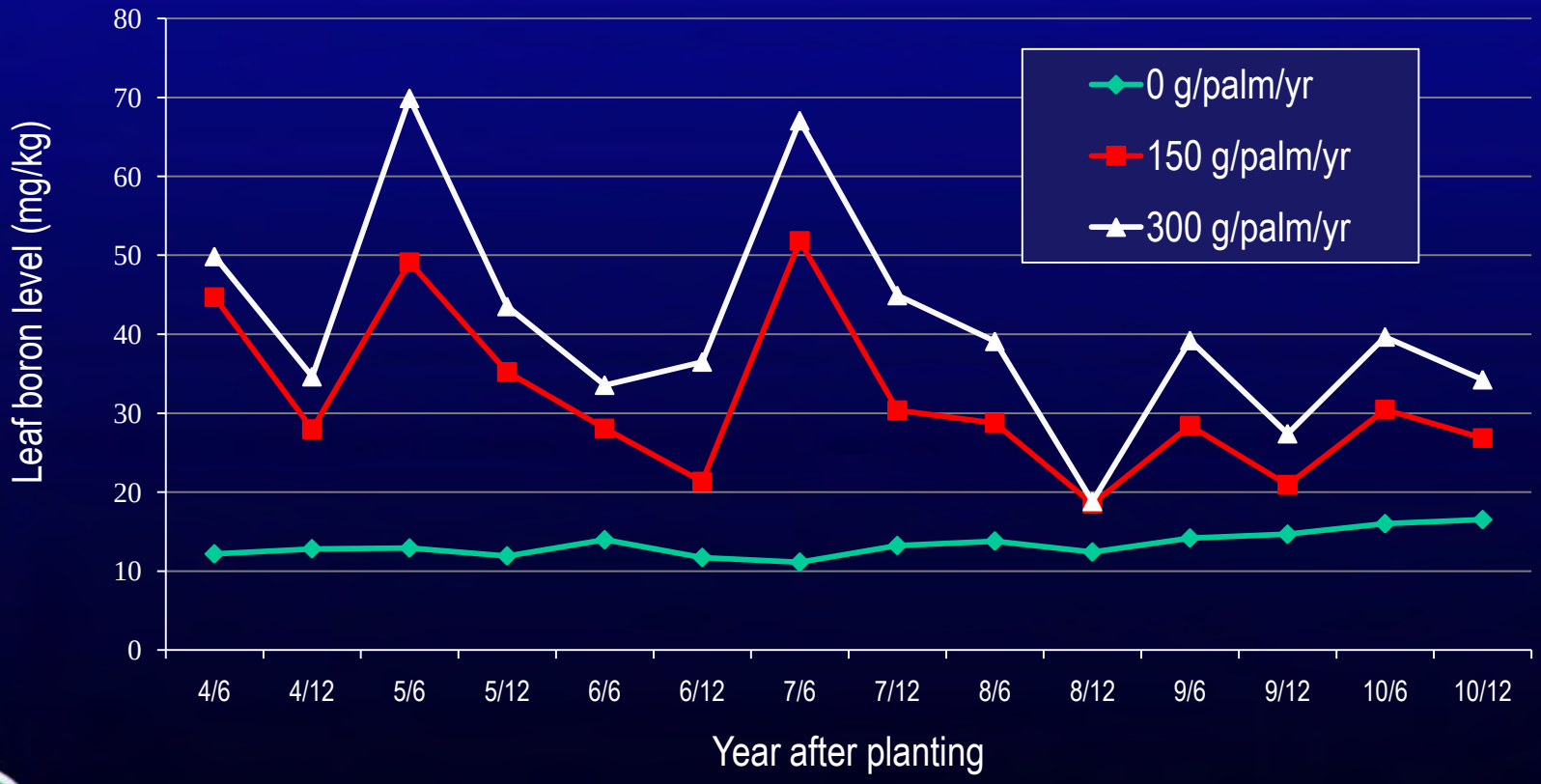
ZnSO4: 200g (Y1); 150g (Y2); 150g (Y3)

Borate 48: 150g alternate year application

Mn & Fe: not applied

Micro Nutrients Requirement

Effect of Boron Application (Borate 48) on Leaf Boron level of Oil Palm on Peat at MPOB Research Station Teluk Intan, Perak.



Technologies are readily available and with the right techniques used, commercial planting of oil palm on the peat can result in profits comparable to those on mineral soils.

Thank you