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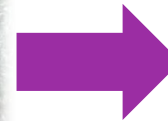


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Effect of Nitrogen Fertilization on Yield of Oil Palm in Tropical Peat



OIL PALM - GOLDEN CROP



National economic crop



World's highest yielding oil crop



Yield/hectare

Soybean



Sunflower



Rapeseed



5-10 times higher



More than 5.0 million hectares of oil palm planted

- ✓ 36% of world's palm oil production in 2012
- ✓ 29% of world's palm oil exports in 2013

- ✓ Poverty alleviation
- ✓ Better living standards

Key contributor

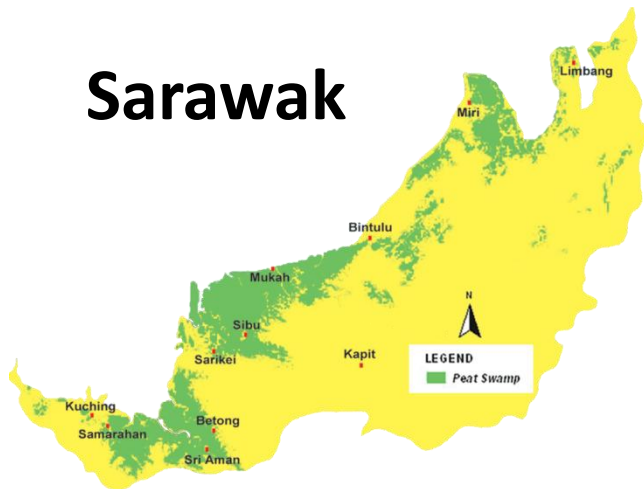
TROPICAL PEATLAND

Peat soils formation:

- ✓ Accumulation of **organic matter**
- ✓ Consist of **partly** or **undecomposed wood pieces**



Sarawak



- ✓ **1.6 million hectares** of tropical peatland
- ✓ Common **depth** range from **5m to 10m**
- ✓ Three main types of peat forest:
 - Mixed peat swamp forest**
 - Alan forest**
 - Padang Paya forest**



NITROGEN IN TROPICAL PEAT SOIL

Can be supplied to palms through mineralization of organic matter but depend on several factors

- ✓ pH
- ✓ C:N ratio
- ✓ temperature
- ✓ Moisture



In Alan forest soils,

- ✓ **High lignin content**
- ✓ **low mineralization rates**



Nitrogen fertilization is still required to make up the remaining balance of nitrogen needed by palms

IMPORTANCE OF NITROGEN

NITROGEN



**Most
important
fertilizer**



Oil palm growth



Speeds growth

Palms receiving adequate nitrogen will have

- **Vigorous growth**
- **Higher leaf production**
- **Longer frond length**

NITROGEN

**Major component of
chlorophyll**

Compound by which plants use sunlight energy to produce **sugars** from **water** & **carbon dioxide** (Evans, 1989).

BEWARE:

Excess fertilization



White stripe symptom



Yield

(Goh & Hardter, 2003)

NITROGEN DEFICIENCY

Commonly found under these conditions:

- **Poorly drained soils or waterlogged areas**
- **High weed density**
- **Poor soil physical characteristics**
 - low bulk density
 - poor root development



FLOODING / WATERLOGGED



STUNTED & FLAT TOP APPEARANCE



HIGH WEED DENSITY



ALAN BATU AREA



NK IMBALANCE



Corrective measures.....

1) **Drainage improvement**

Open additional field drain

Example: from 4 in 1 to 2 in 1 or soil mounding



2) **Proper water management**

- Maintain water level at 50-75cm



3) **Destumping and compaction**

- Improve soil bulk density and root development

4) **Maintain a weed free palm circle all year round**

GOOD DESTUMPING & COMPACTION



GOOD WATER LEVEL MANAGEMENT



NITROGEN FERTILIZER STUDY

- Young mature palms
 - **Age** : 2004 planting, 5th-8th YAP
 - **Study site** : Alan forest in Sibul, Sarawak
 - **Planting density**: 153 palms /ha
 - **Data collection** : 2009-2012
 - **Annual rainfall**: 2500-3500mm
 - **Water level** : 50-75cm

ANNUAL WATER LEVEL AND RAINFALL

Year	Rainfall (mm)	Water level (cm)
2009	3137	59.5
2010	3246	55.2
2011	2897	61.1
2012	3286	59.2

OBJECTIVE

To investigate the effects of different **nitrogen rates** on oil palm in terms of,

- i) **Total and available nitrogen in soil**
- ii) **Leaf nutrient composition**
- iii) **Vegetative growth**
- iv) **Oil palm yield.**

Nitrogen Fertilizer



Total N & available N



Leaf nutrient



Vegetative growth



Oil palm yield

FERTILIZER APPLICATION

Nitrogen source

- Ammonium sulphate $((\text{NH}_4)_2\text{SO}_4)$
- Applied evenly within a 2m circle radius

4 treatments evaluated

- i) 0 kg SOA (Control)
- ii) 1kg SOA (N1)
- iii) 2kg SOA (N2)
- iv) 4kg SOA (N4)

Other fertilizers

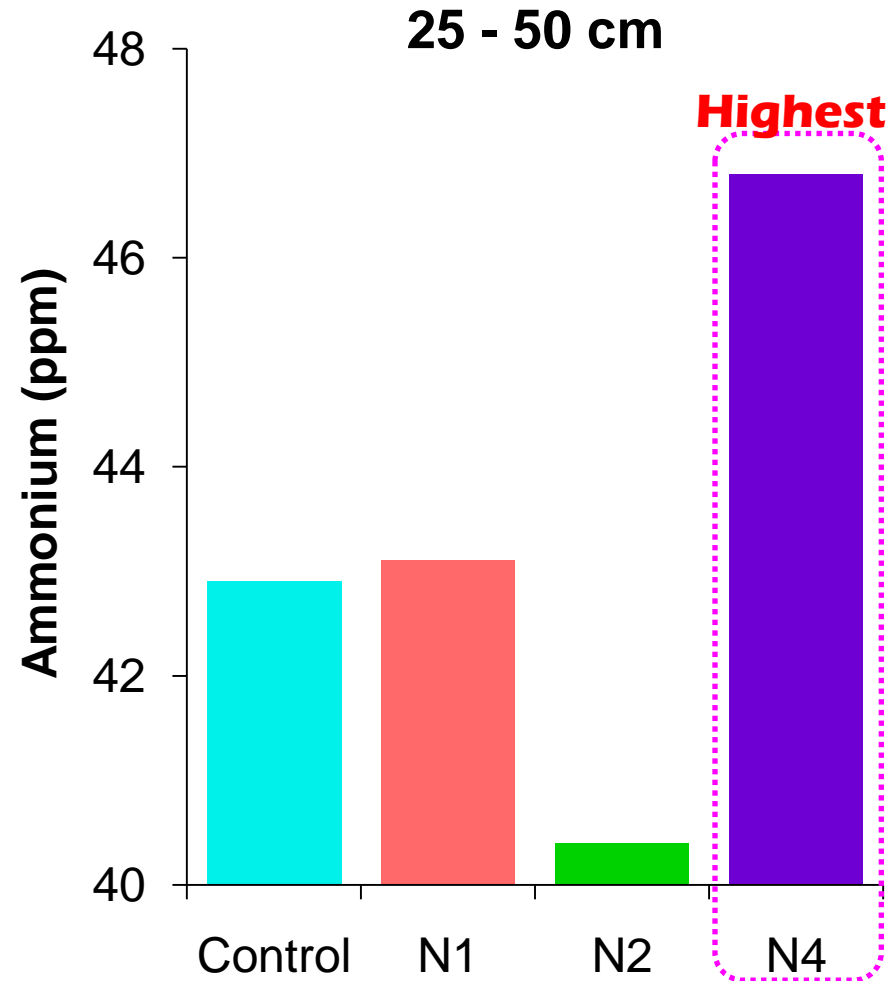
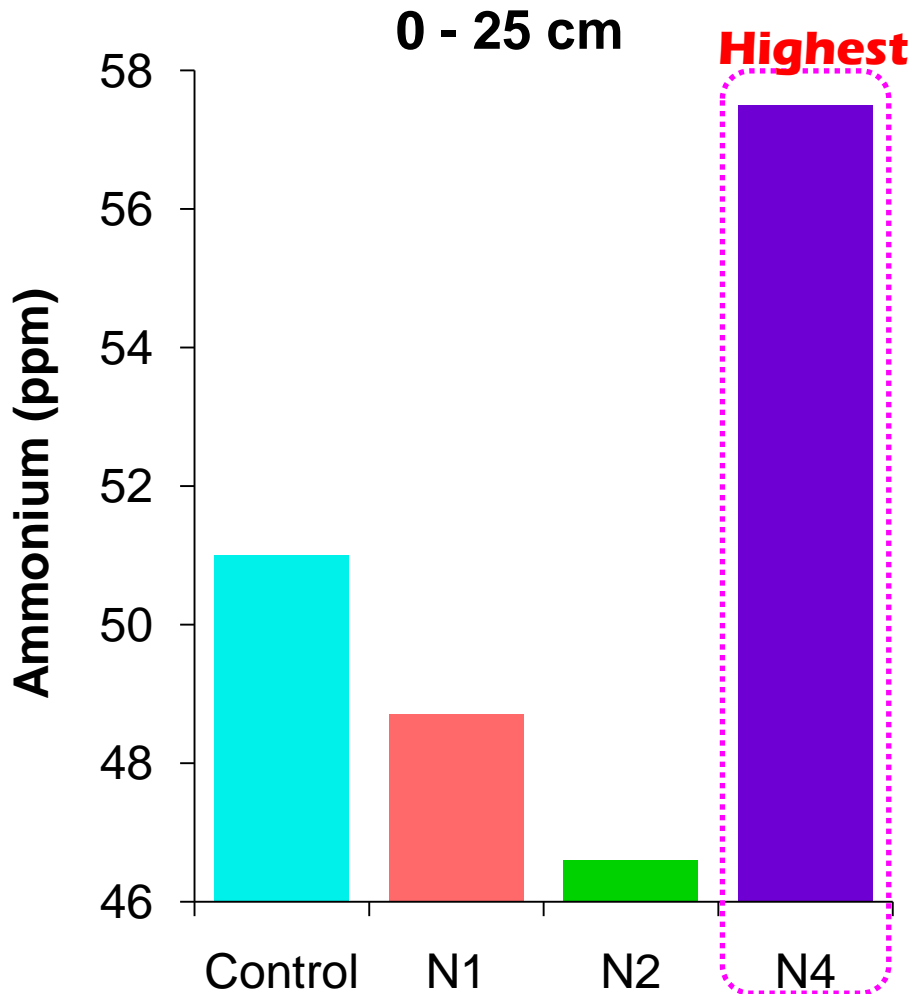
- # 1.75 kg P
- # 5.2 kg K
- # 1.75 kg Mg
- # 0.15 kg Zn
- # 0.15 kg Cu
- # 0.15 kg B



SOIL PROPERTY

Soil depth (cm)	Treatment	pH	Loss of ignition	Total N	Ammonium
0 - 25	Control	3.57	97.2	2.0	51.0
	N1	3.59	97.3	1.9	48.7
	N2	3.58	97.4	1.9	46.6
	N4	3.49	97.3	2.0	57.5
25 -50	Control	3.45	98.1	1.8	42.9
	N1	3.43	98.2	1.8	43.1
	N2	3.39	98.3	1.7	40.4
	N4	3.37	98.4	1.8	46.8

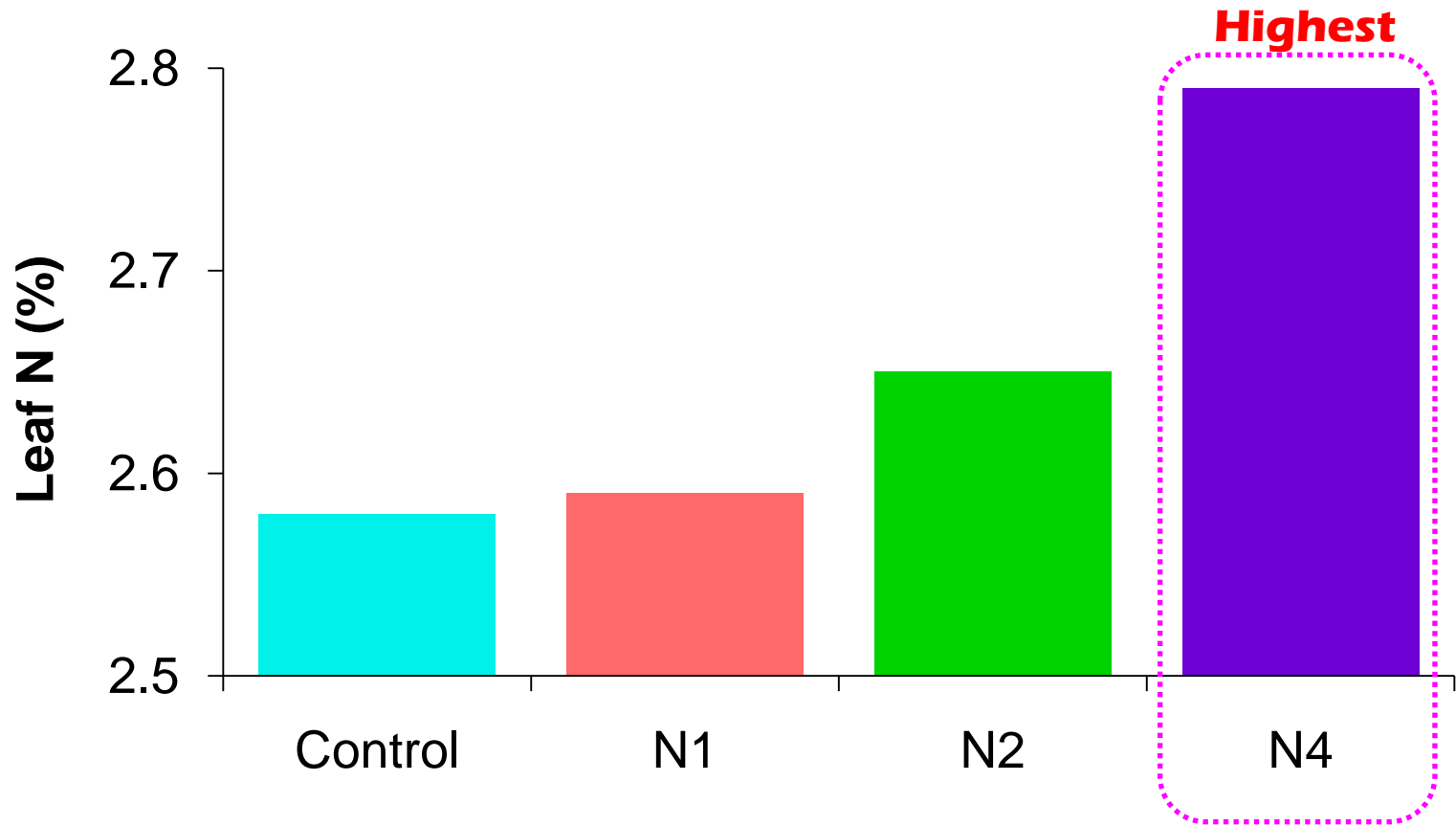
SOIL AVAILABLE N - AMMONIUM



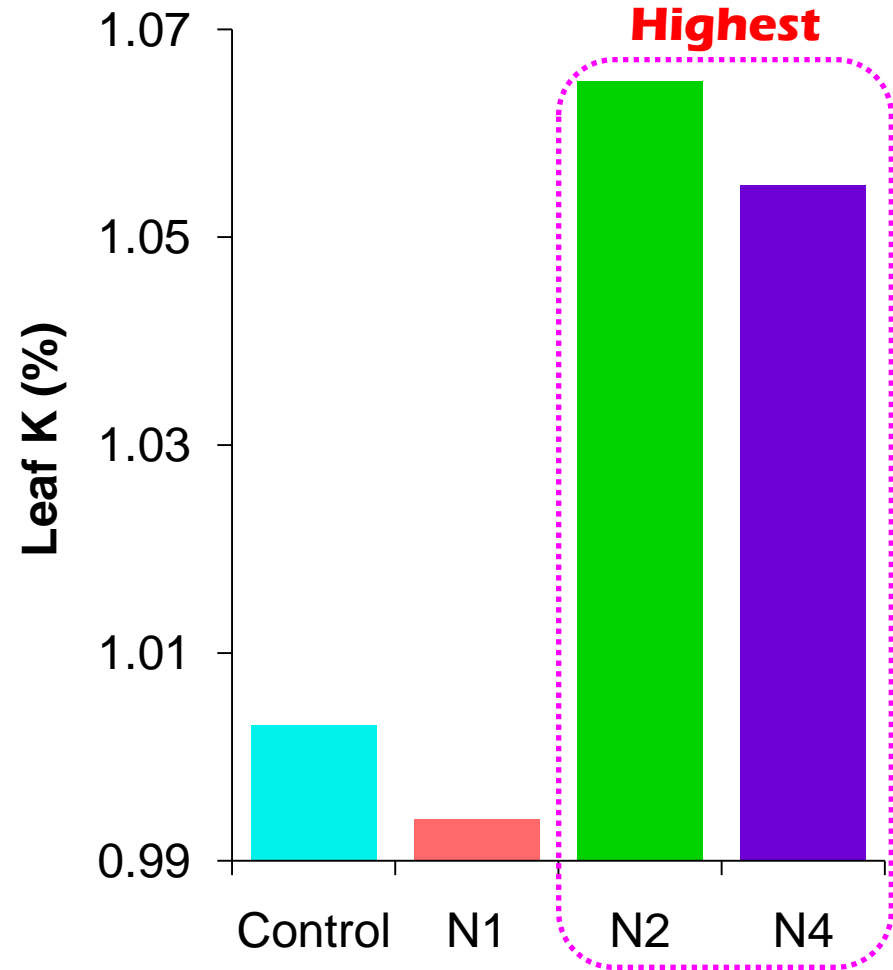
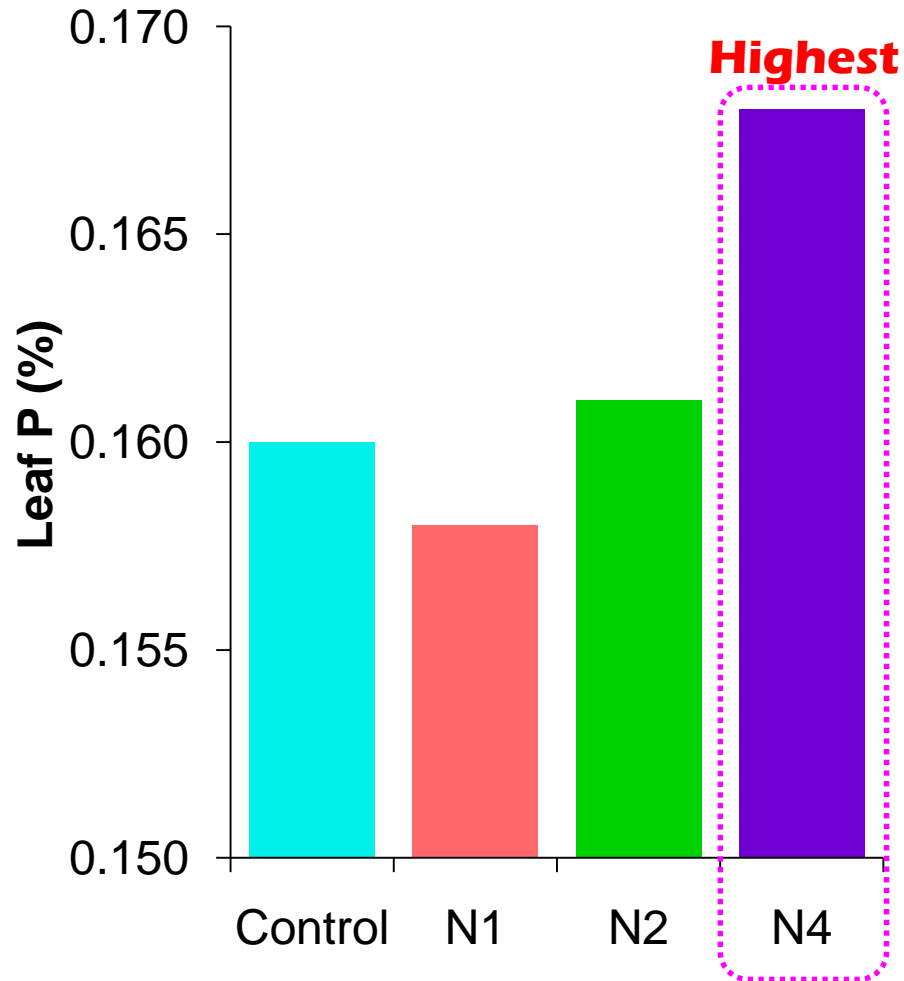
LEAF NUTRIENT COMPOSITION

Leaf nutrient	N fertilizer rate			
	Control	N1	N2	N4
N (%)	2.58	2.59	2.65	<u>2.79</u>
P (%)	0.16	0.16	0.16	0.17
K (%)	1.00	0.99	1.07	1.06
Mg (%)	0.26	0.25	0.26	0.25
Ca (%)	0.52	0.51	0.48	0.44

LEAF NITROGEN (N)



LEAF PHOSPHORUS (P) & LEAF POTASSIUM (K)

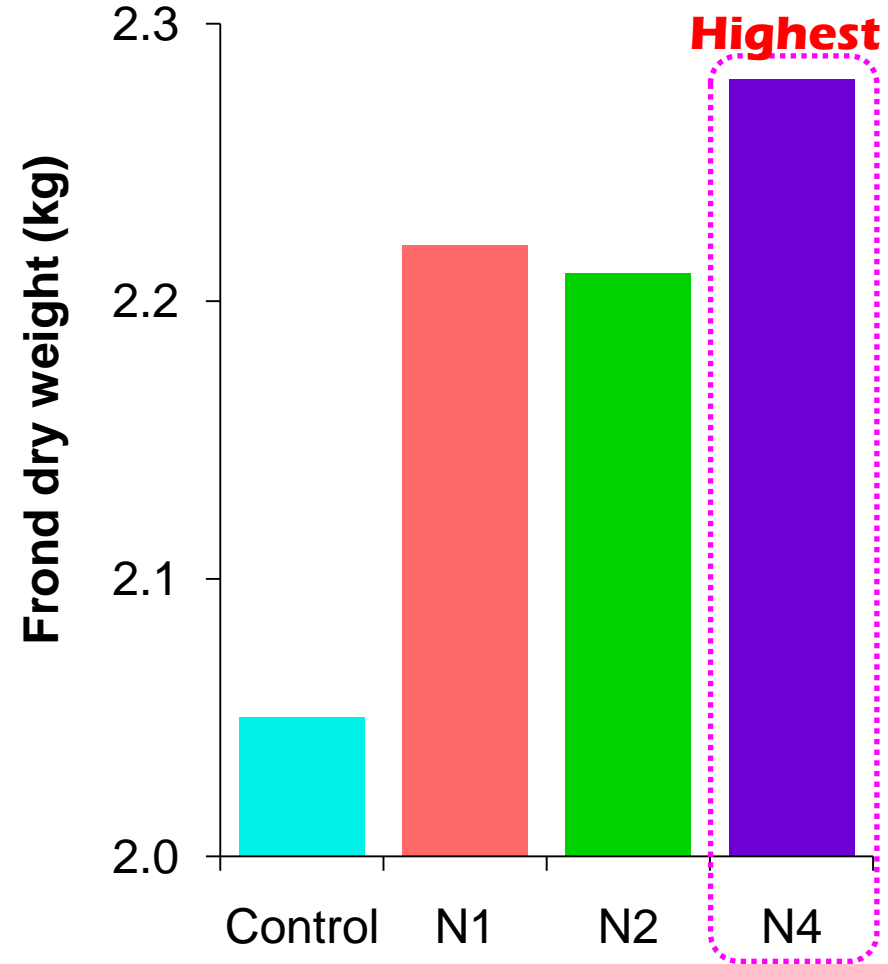
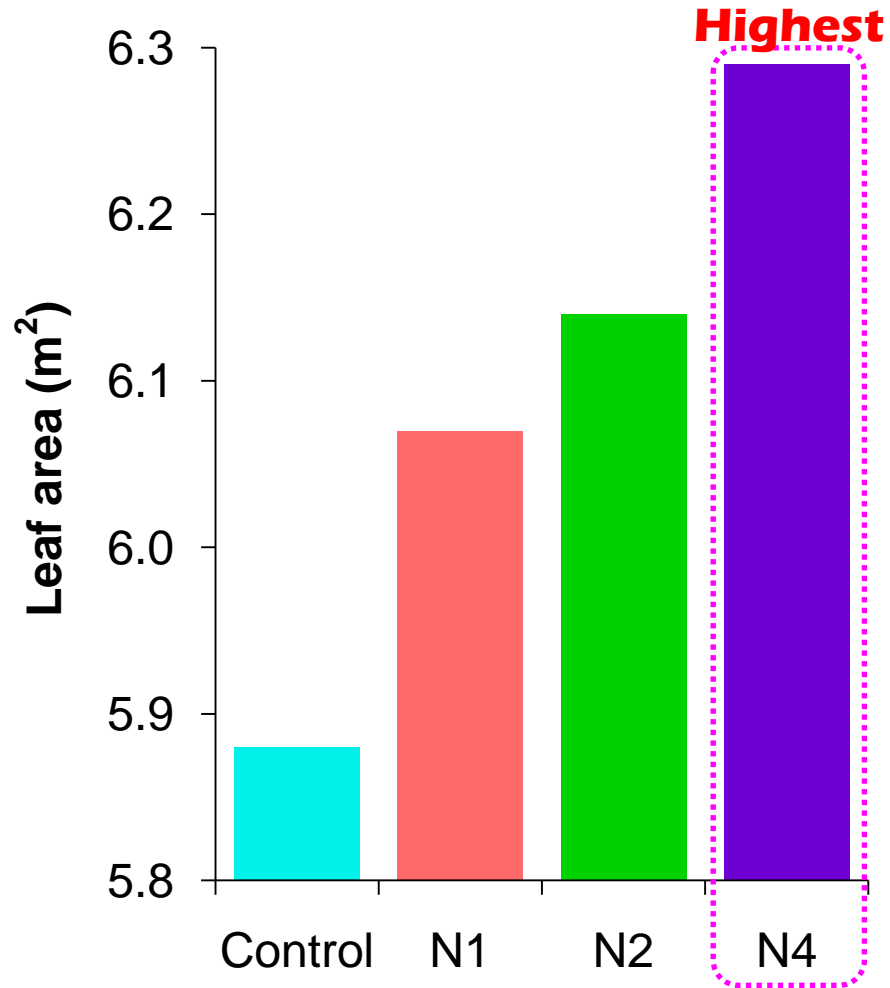


VEGETATIVE GROWTH MEASUREMENTS

Palm growth	N fertilizer rate			
	Control	N1	N2	N4
Leaf area (m ²)	5.88	6.07	6.14	6.29
Leaf area index	3.25	3.36	3.45	3.52
Frond dry weight (kg)	2.05	2.22	2.21	2.28

LEAF AREA

& FROND DRY WEIGHT



LEAF AREA INDEX - N4 OVER CONTROL

Treatment	2011	2012	Mean
Control	3.27	3.60	<u>3.44</u>
N1	3.43	3.78	3.60
N2	3.49	3.89	3.69
N4	3.89	4.03	<u>3.96</u>

$N4 / \text{Control} \times 100\% = 115.1\%$

Leaf area index is 15.1% higher than “no fertilizer application”

OIL PALM YIELD

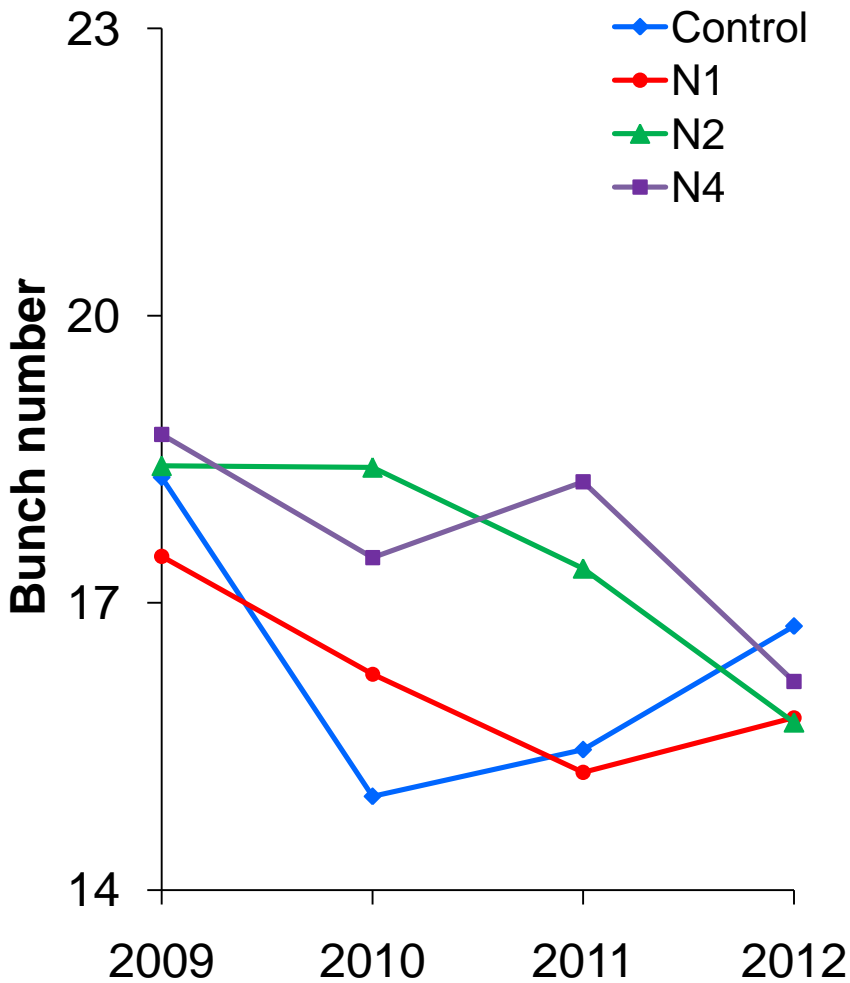


Palm Yield	Control	N1	N2	N4
Bunch number	16.40	16.20	17.50	17.70
Average bunch weight (kg/bunch)	6.98	7.33	7.09	7.70
FFB (tan/ha/year)	17.30	17.60	18.90	<u>20.30</u>

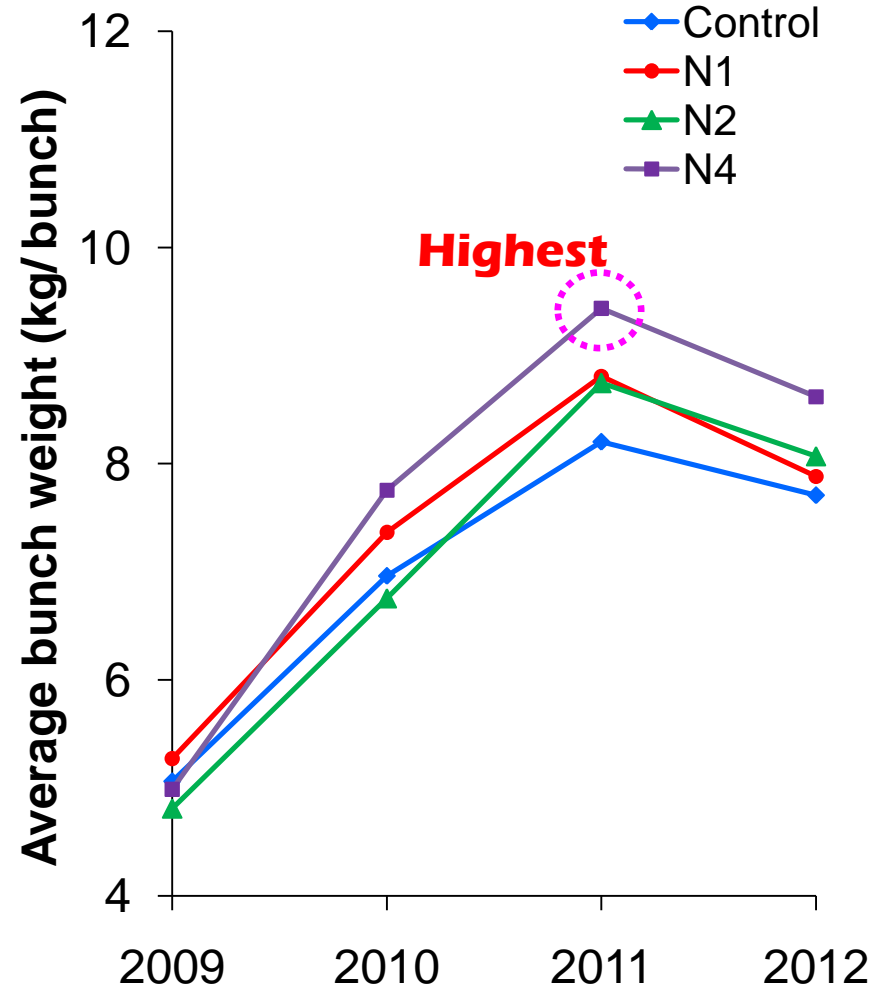


OIL PALM YIELD ~ 2009-2012

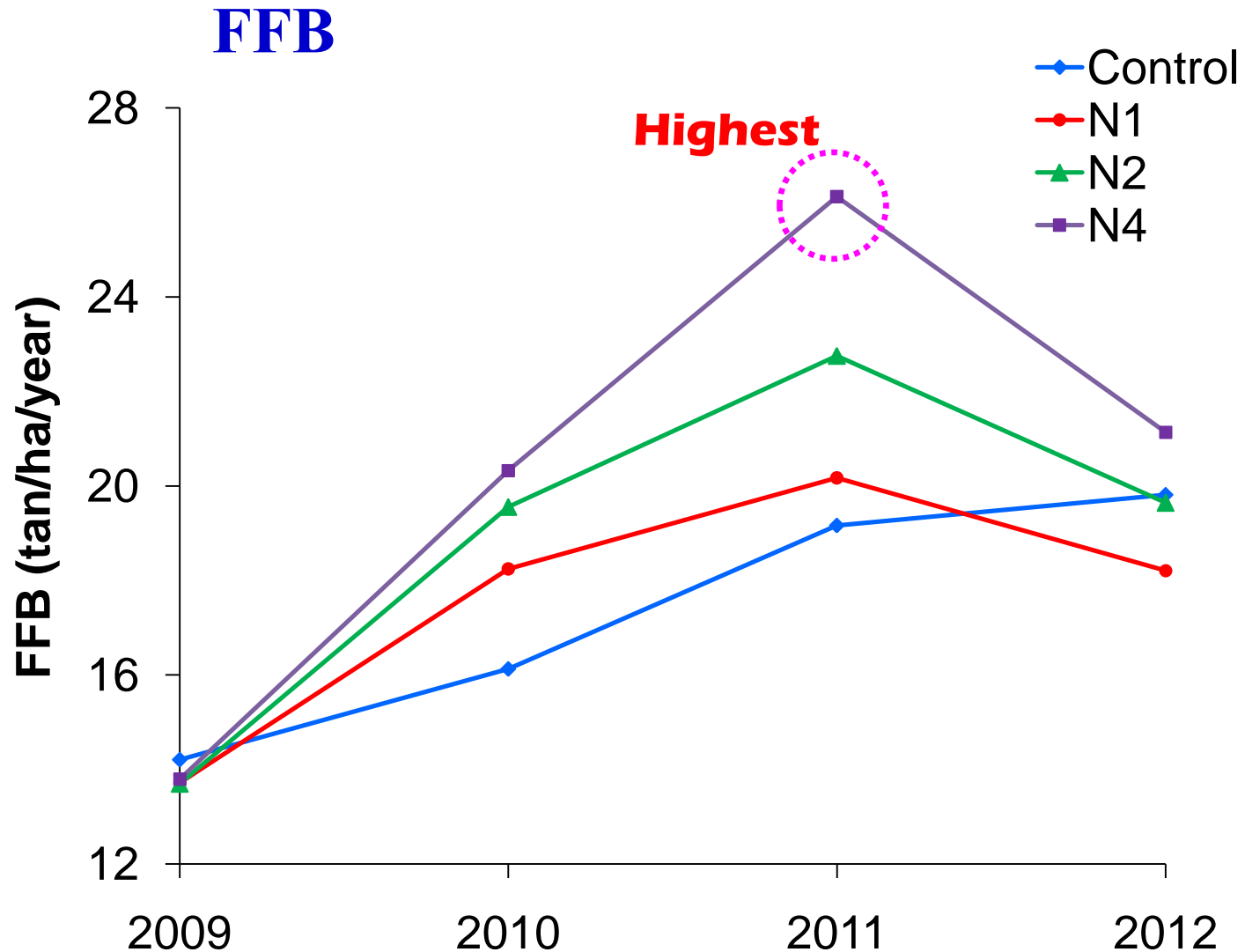
Bunch number



Average bunch weight

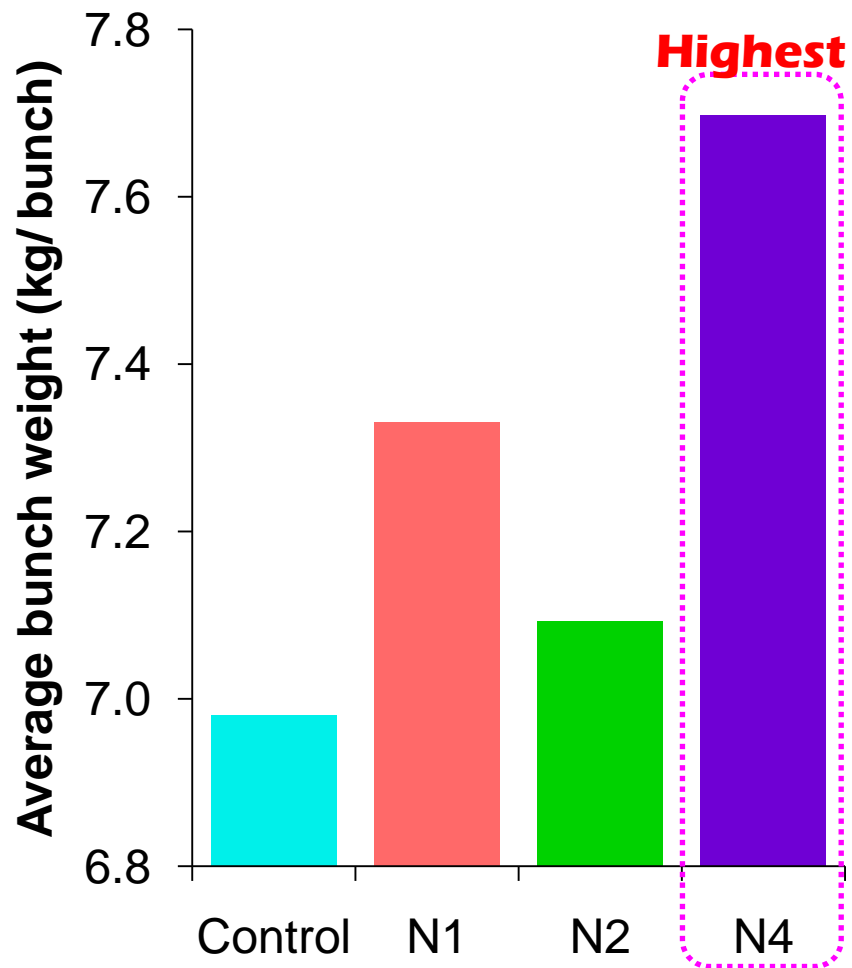
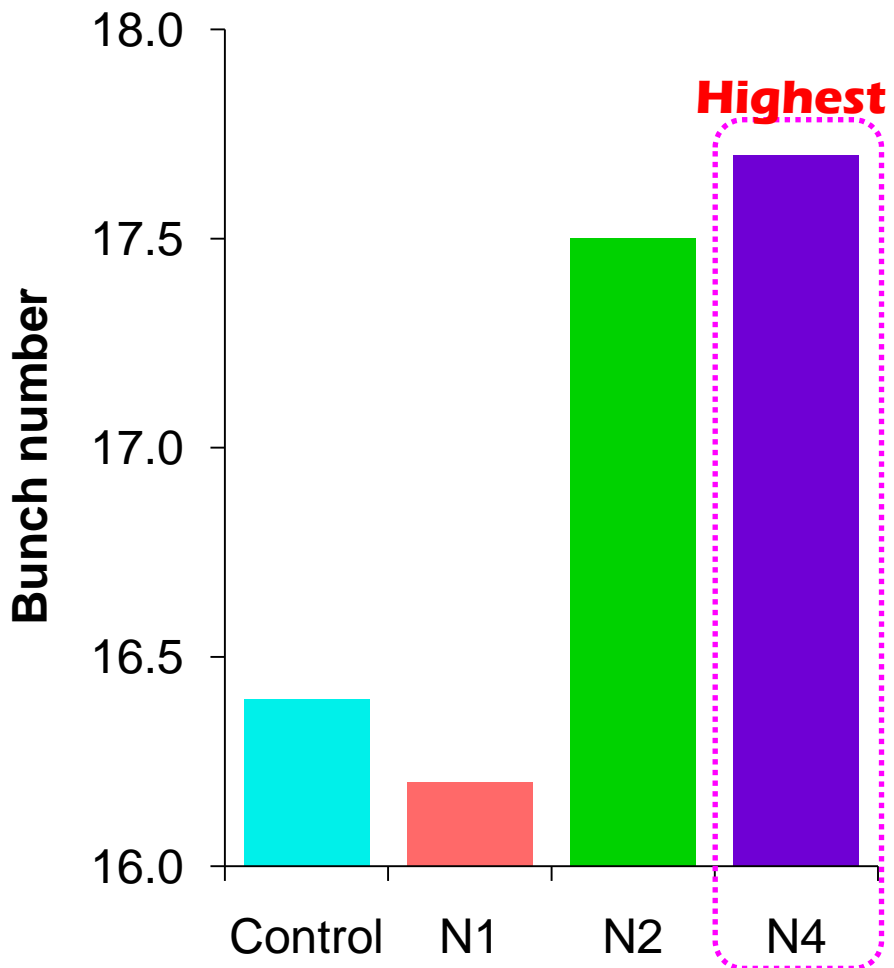


OIL PALM YIELD ~ 2009-2012

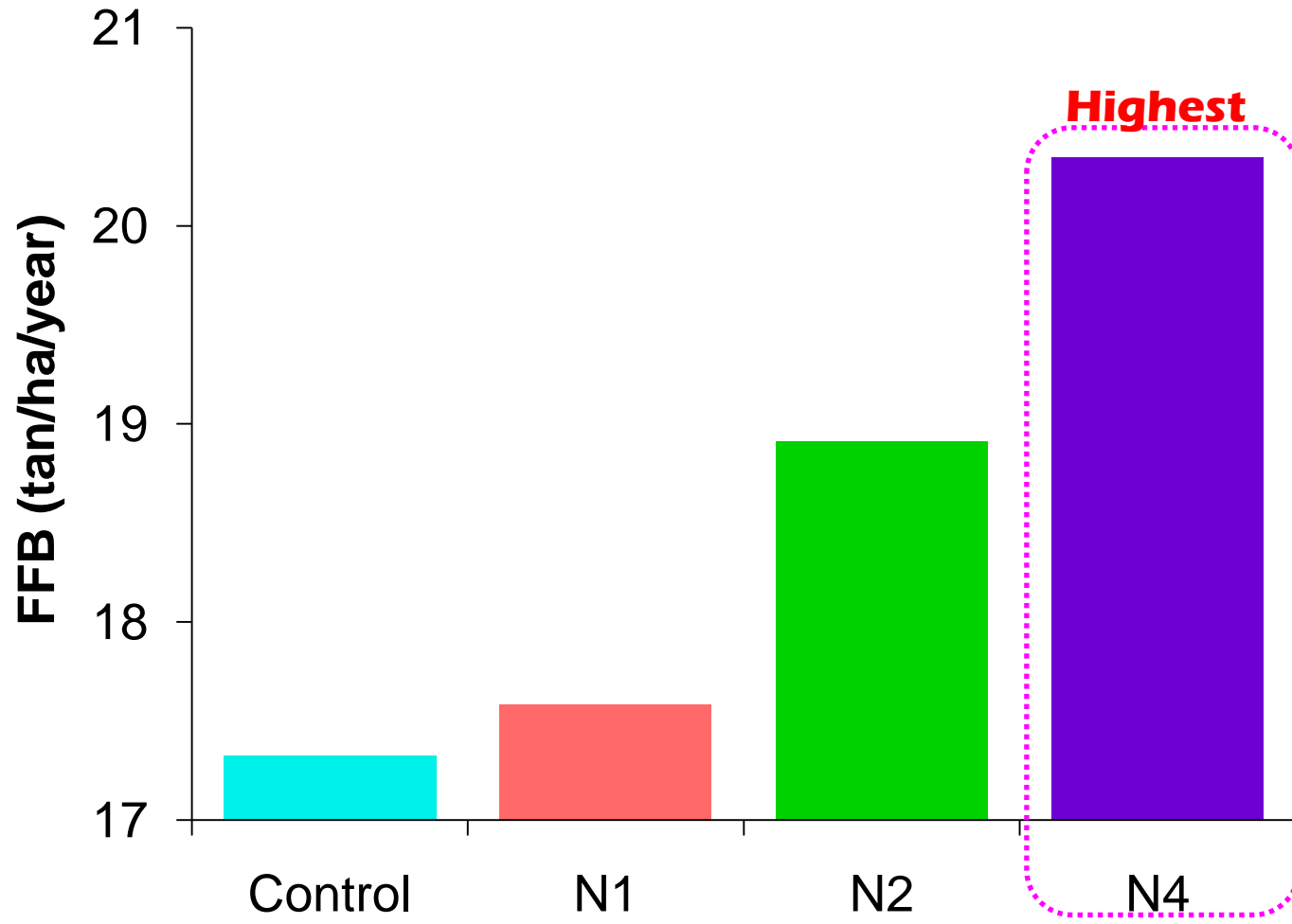


BUNCH NUMBER

& AVERAGE BUNCH WEIGHT



FFB



FFB - N4 OVER CONTROL

Treatment	2011	2012	Mean
Control	19.2	19.8	<u>19.5</u>
N1	20.2	18.2	19.2
N2	22.8	19.6	21.2
N4	26.1	21.1	<u>23.6</u>

$N4 / \text{Control} \times 100\% = 121\%$

FFB is 21% higher than “no fertilizer application”

CONCLUSION

The highest oil palm yields and growth were attained at N4 with

- Larger leaf area
- Higher frond dry weight
- Higher leaf N concentration



HIGH YIELDING PALM



Acknowledgements



Ta Ann Holdings Berhad



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THANK YOU!

