4R Nutrient Stewardship
Major Crops of Southeast Asia
Good Reasons to Engage

IPNI Southeast Asia Program for:

IFA INDONESIA SEMINAR ON SUSTAINABLE FERTILIZER MANAGEMENT
Jakarta, 23 April 2014

4R Nutrient Stewardship
Major Crops of Southeast Asia
Good Reasons to Engage

1. **4 "Rights" Nutrient Stewardship Concept**
2. **Opportunity in Major Crops**
3. **Examples of IPNI SEAP R&D**

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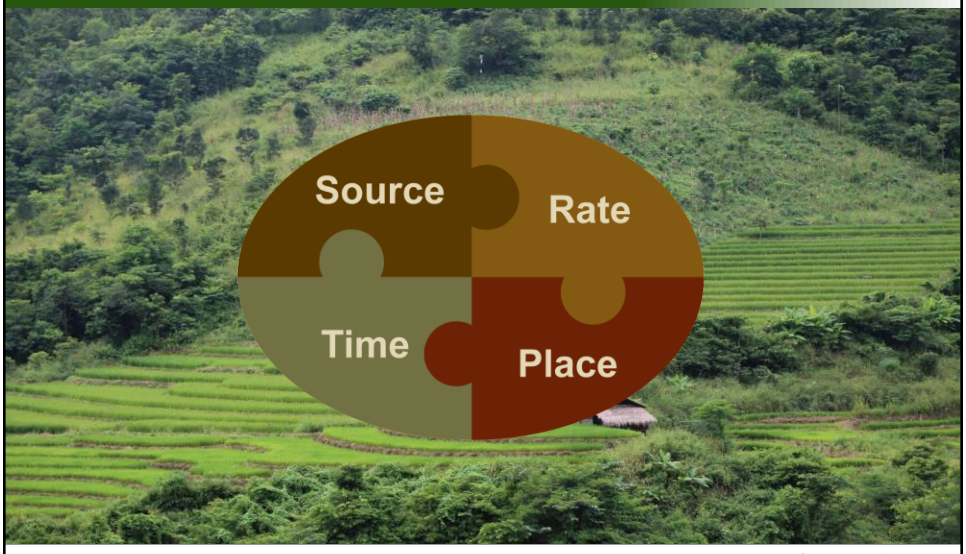
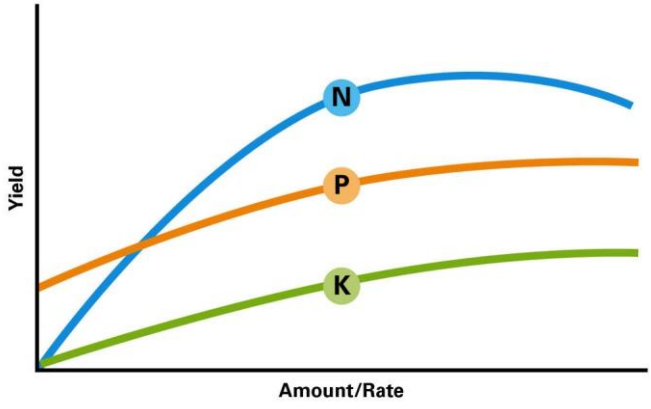
4R Concept



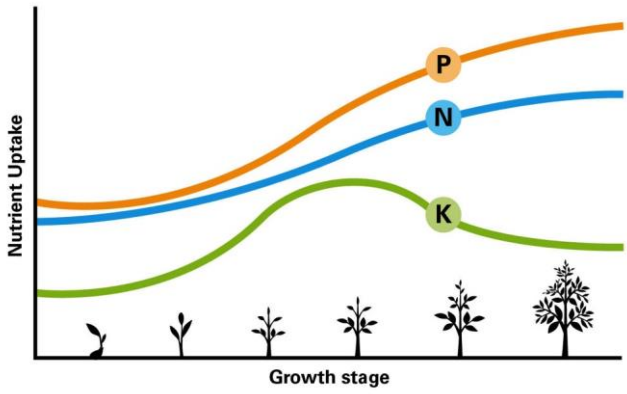
4R Concept



Right *RATE*

Assess soil nutrient supply and plant demand for nutrients for a specific yield target

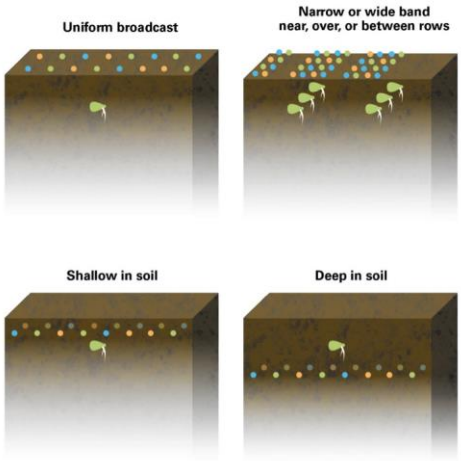
4R Concept



Right *TIME*

Assess timing of crop uptake, soil nutrient supply, loss risks and field operation logistics

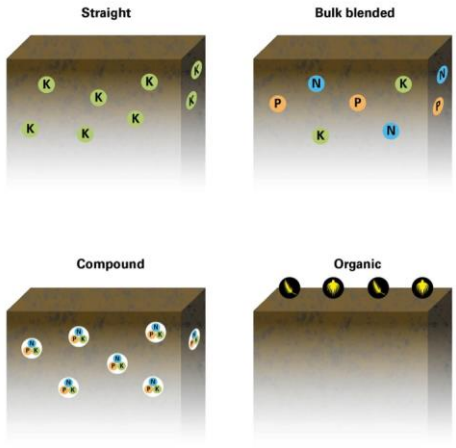
4R Concept



Right *PLACE*

Place nutrients where they are accessible to crop

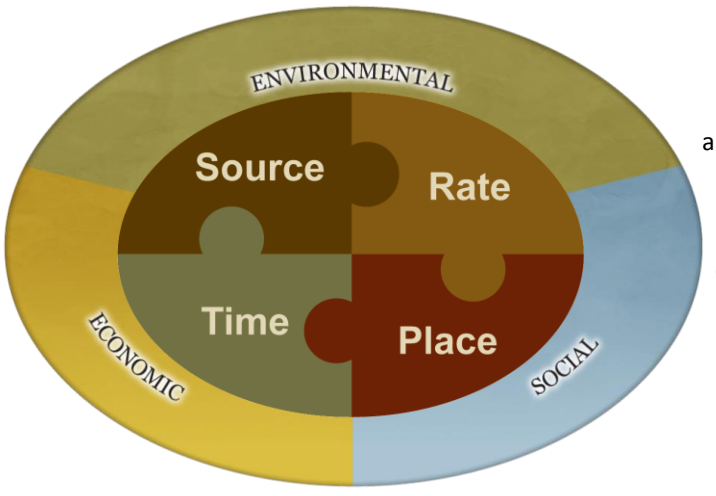
4R Concept



Right *SOURCE*

Ensure balanced supply of plant-available nutrients, utilizing all available sources (organic, inorganic)

4R Concept



Beyond *N-P-K*

Societal norms and expectations, measured by performance indicators, and determined by a range of stakeholder

Opportunity in Major Crops

Selection Criteria

- Production area
- Extractive (and not fertilized)
- Market demand
- Responsive crop
- Yield gap

Opportunity in Major Crops

Production Area (FAO, 2010, ha)

- Rice (**37,894,000**)
- Maize (**8,929,000**)
- Oil palm (**10,483,000**)
- Sugar cane (**2,052,000**)
- Cassava (**3,070,000**)
- Cocoa (**1,673,000**)

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Opportunity in Major Crops

N-P-K Fertilizer Use (IFA, 2010, t)

Rice[#]	(**3,716,000**)
Maize[#]	(**1,023,000**)
Oil palm[+]	(**2,618,000**)
Sugar cane[+]	(**459,000**)
Cassava[*#+-]	(**150,000**)
Cocoa[*#-]	(**15,000**)

* IPNI SEAP estimates
\# Highly nutrient extractive crops
\+ Highly yielding crops
\- Currently non intensive

Opportunity in Major Crops

	Yield Gap $_{t/ha}$	Nutrient Gap $_{kg/ha}$			Market $_{t\ accumulated\ for\ five\ selected\ countries}$		
	$Y_{Act} - Y_{Att}$	N	P	K	N	P	K
Rice	3.8	85	16	92	**2,102,382**	**388,797**	**2,289,581**
Maize	4.3	184	26	177	**691,074**	**98,286**	**668,038**
Oil Palm	4.3	70	7	75	**732,500**	**74,377**	**791,100**
Sugar Cane	11.6	73	29	139	**54,735**	**21,656**	**104,710**
Cassava	16.5	142	26	208	**227,939**	**42,042**	**334,311**
Cocoa	5.6	210	42	136	**187,401**	**37,480**	**121,811**

Opportunity in Major Crops

	Product **Present**	Product **New**	Technology **New**
Market **Present**	**Market Penetration**	**Product Development**	**Technological Product Substitution**
Market **New**	**Market Development**	**Diversification**	**High Technology**

Opportunity in Major Crops

	Product **Present**	Product **New**	Technology **New**
Market **Present**	**Market Penetration** Rice R_T, R_P Sugar R_T, R_P Oil R_T, R_P Maize R_T, R_P	**Product Development** Rice R_R Sugar R_R Oil R_R Maize R_R, R_S	**Technological Product Substitution** Rice R_S Sugar R_S Oil R_S
Market **New**	Cocoa R_T, R_P Cassava R_T, R_P **Market Development**	Cocoa R_R, R_S Cassava R_R, R_S **Diversification**	**High Technology**

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Opportunity in Major Crops

	Advantage **Small**	Advantage **Large**
Approaches **Many**	**Fragmented**	**Specialization**
Approaches **Few**	**Stalemate**	**Volume**

Opportunity in Major Crops

	Advantage **Small**	Advantage **Large**
Approaches **Many**	**Fragmented**	**Specialization**
Approaches **Few**	Cocoa Cassava **Stalemate**	Oil Palm Rice Sugar Maize **Volume**

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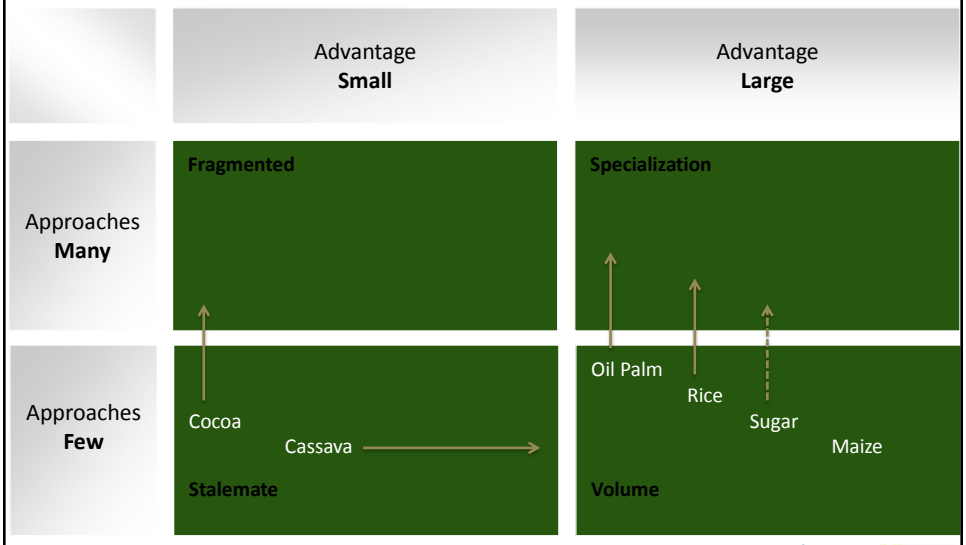
Opportunity in Major Crops



Illustrative IPNI R&D Examples

Systems Information clarifies and quantifies the opportunity for fertilizer use and marketing. It is produced by analyzing the performance of crops and fertilizers within a geographic region / domain and season(s).

4R Interventions support decisions about fertilizer use in the commercial agronomic process. The are produced by testing the performance of fertilizers in production systems.

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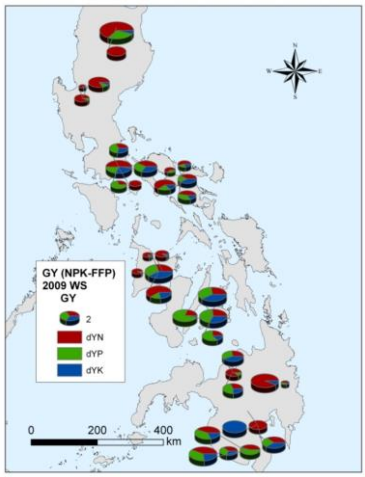
Systems Information Maize

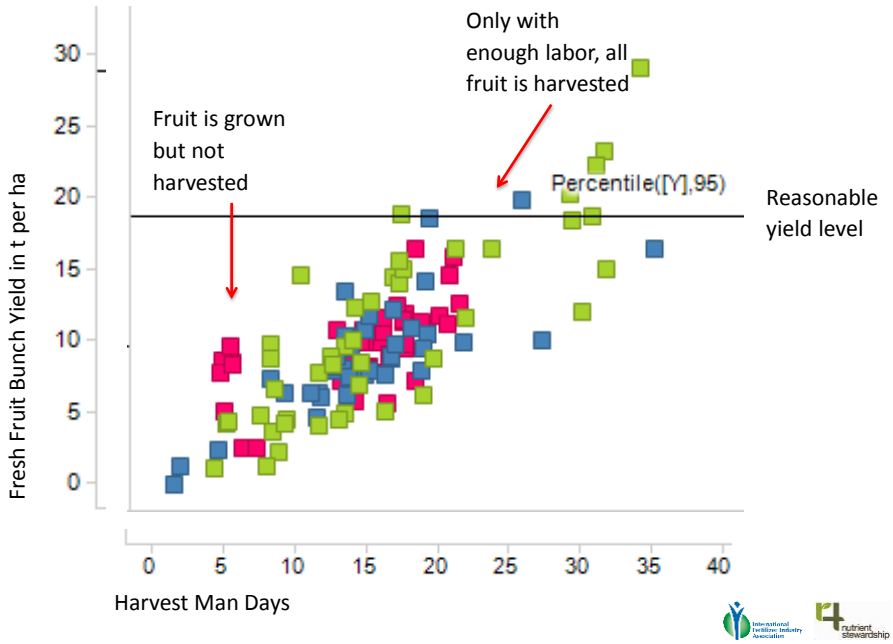


Maize: Right Rate

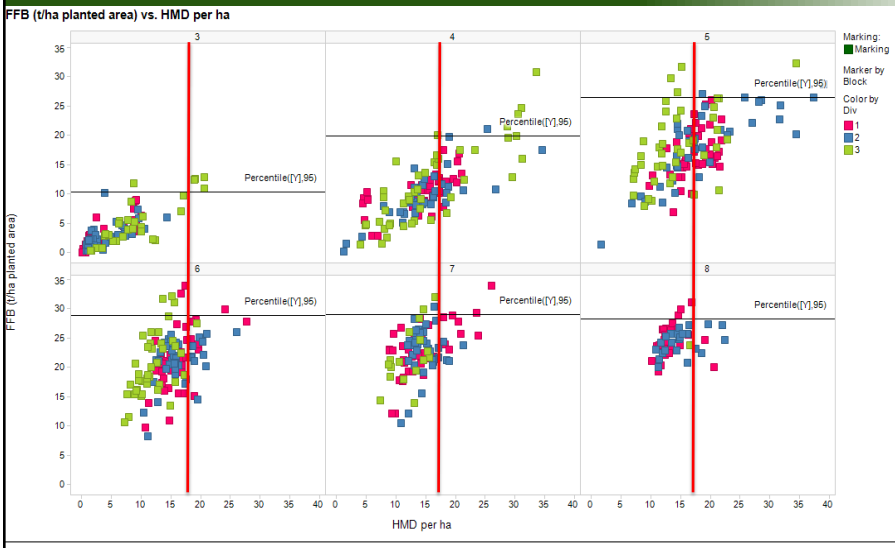
Parameter	Unit	FFP	4R	4R– FFP
Grain yield	t/ha	7.5	8.4	0.9
Fertilizer N	kg/ha	173	160	-12
Fertilizer P_2O_5	kg/ha	43	33	-10
Fertilizer K_2O	kg/ha	28	41	+13
Fertilizer cost	USD/ha	126	126	0
Return	USD/ha	1761	2032	+271

Systems Information Oil Palm

Lack of Clear Fertilizer Response in Oil Palm Plantations leads to Fertilizer Complacency in Plantations



Systems Information Oil Palm

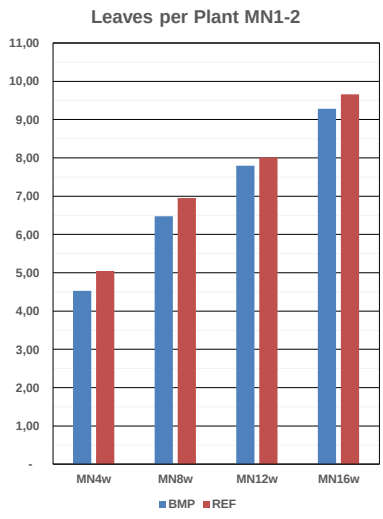


Systems Information Oil Palm

There <u>is</u> Fertilizer Response in Oil Palm Plantations but it is Compounded by other Factors, including Labor Allocation and Climate

Oil Palm Nursery: Right Source

Oil Palm Nursery: Right Source



Main Nursery (MN)

Fertilizer Quality in BMP

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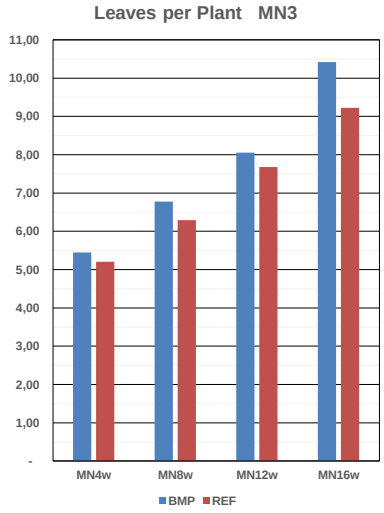
Oil Palm Nursery: Right Source



Main Nursery (MN)

Fertilizer Quality in BMP

Oil Palm: Right Source, Time

Mature Palms

On-site blending of "Straights"

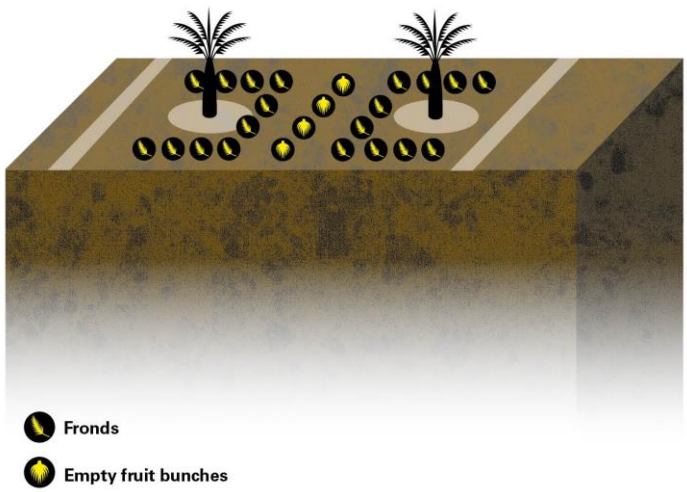
4 Application rounds per year

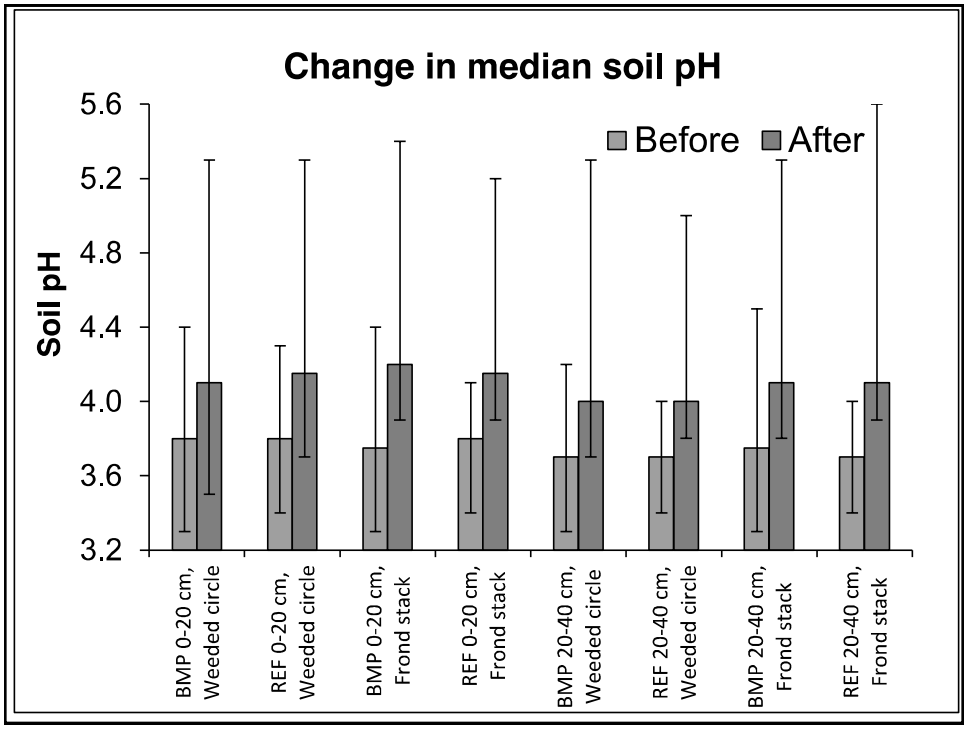
(SEP: 6 to 8 for straights)

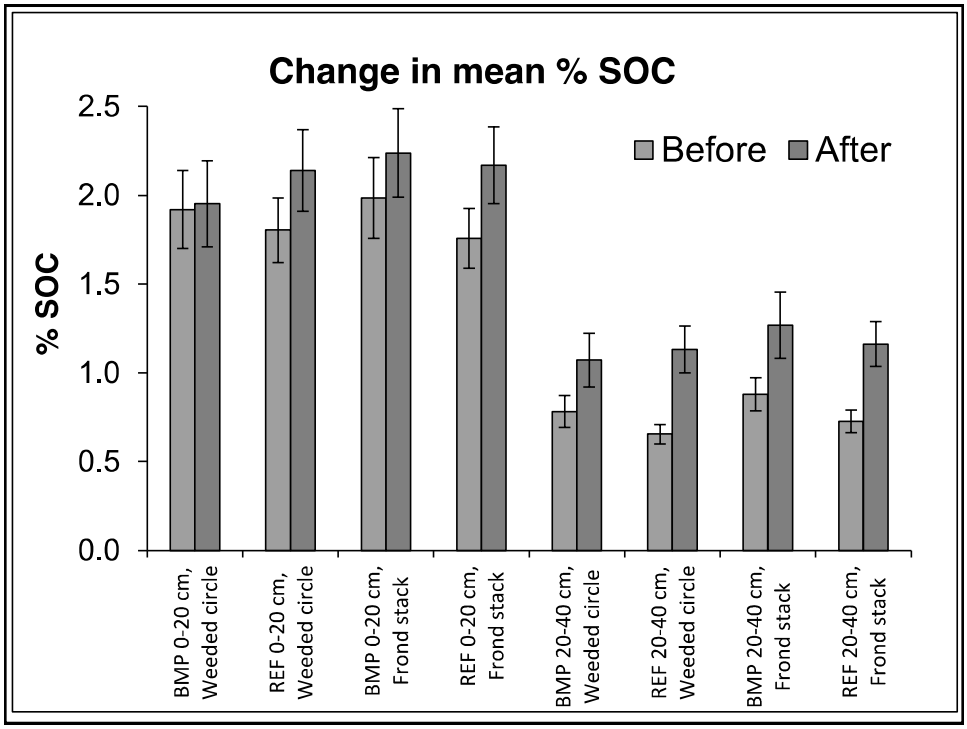
Oil Palm: Right Source, Time

	N	P	K
4R Fertilizer Nutrient Supply (kg/ha)	134.6	12.2	243.0
Nutrient Removal (kg/ha)	78.7	8.7	107.2
Fertilizer Recovery Efficiency (%)	**58.5**	**71.5**	**44.1**
SEP Fertilizer Nutrient Supply (kg/ha)	129.2	11.7	233.3
Nutrient Removal (kg/ha)	68.5	8.3	87.2
Fertilizer Recovery Efficiency (%)	**53.0**	**71.2**	**37.4**

Oil Palm: Right Source, Place




Change in median soil pH
Soil pH
5.6
5.2
4.8
4.4
4.0
3.6
3.2
Before
After
BMP 0-20 cm, Weeded circle
REF 0-20 cm, Weeded circle
BMP 0-20 cm, Frond stack
REF 0-20 cm, Frond stack
BMP 20-40 cm, Weeded circle
REF 20-40 cm, Weeded circle
BMP 20-40 cm, Frond stack
REF 20-40 cm, Frond stack


Change in mean % SOC
% SOC
2.5
2.0
1.5
1.0
0.5
0.0
Before
After
BMP 0-20 cm, Weeded circle
REF 0-20 cm, Weeded circle
BMP 0-20 cm, Frond stack
REF 0-20 cm, Frond stack
BMP 20-40 cm, Weeded circle
REF 20-40 cm, Weeded circle
BMP 20-40 cm, Frond stack
REF 20-40 cm, Frond stack

Cacao: Right Rate, Source

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IPNI COCOA CARE PROJECT

Sustainable Intensification

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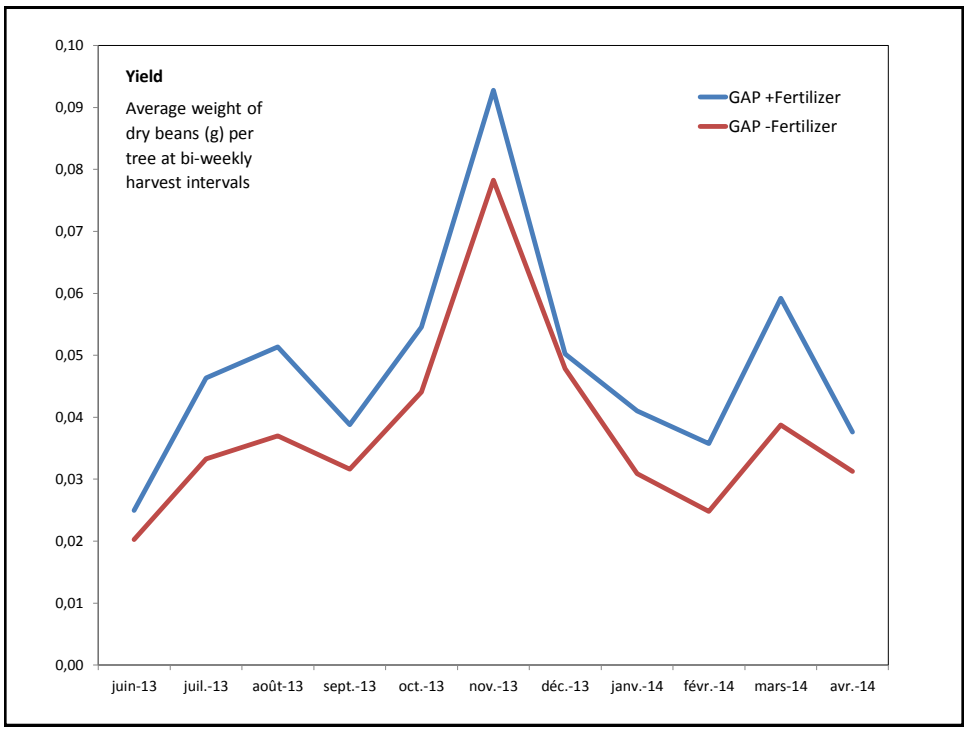

Thank you

Contact: *toberthur@ipni.net*

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R&D Examples

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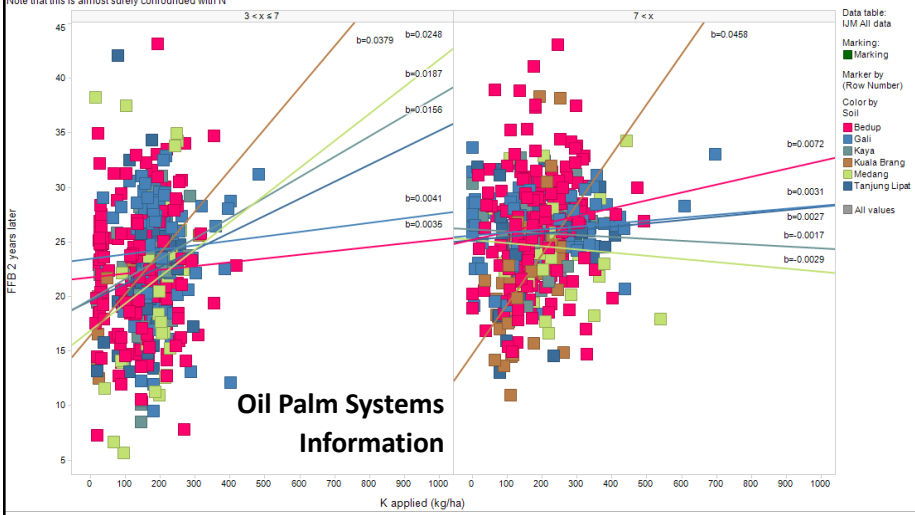
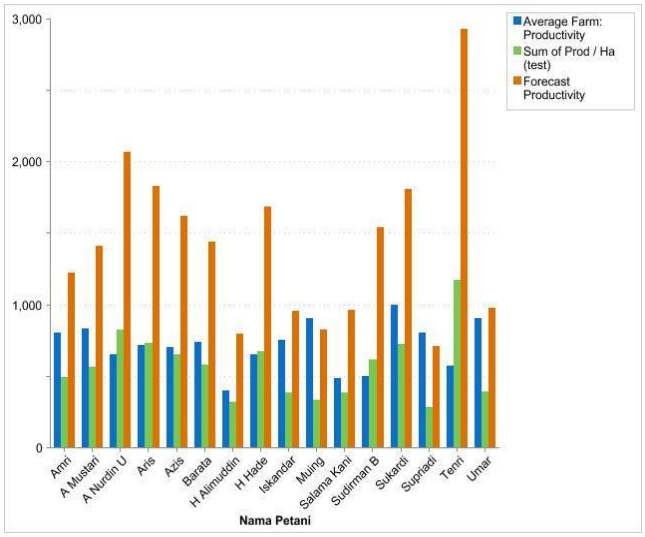
Apparent K effect for 6 soil units

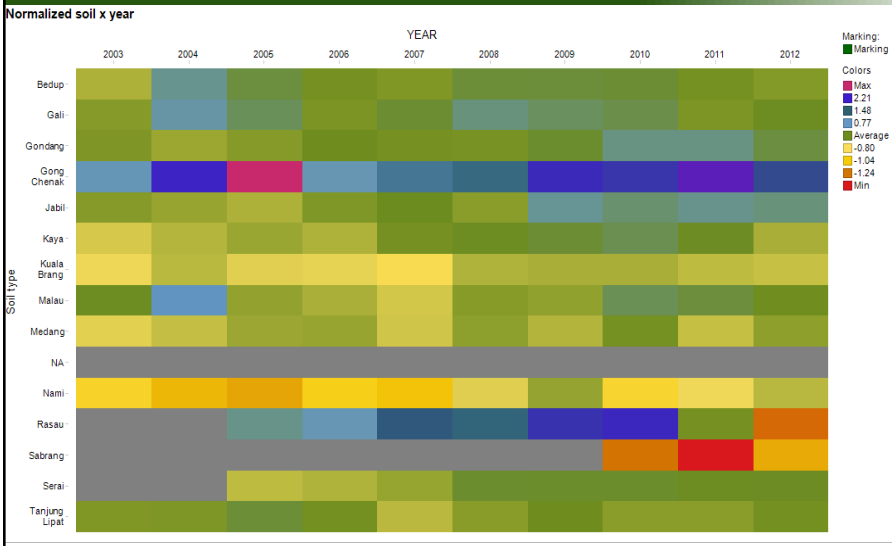
Note that this is almost surely confounded with N



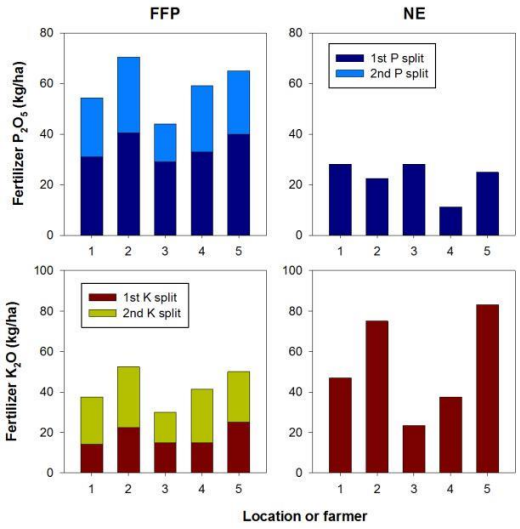
Rate, Source, Place Cacao



R&D Examples



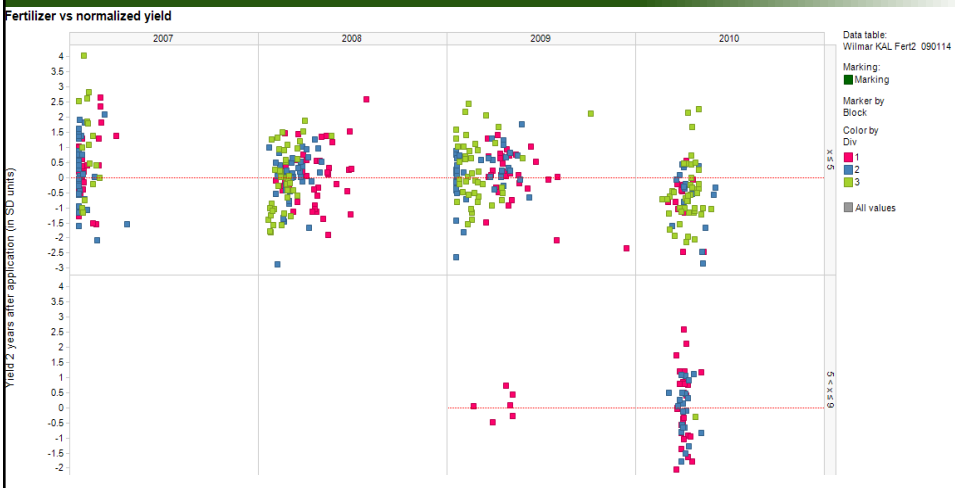
R&D Examples



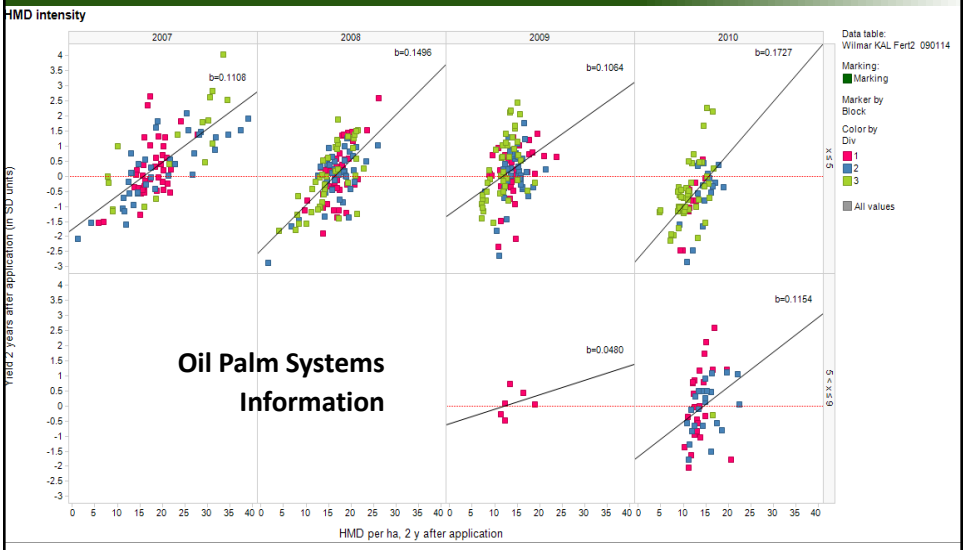
Maize Management Information

Right ***T S R***

Systems Information Oil Palm



Systems Information Oil Palm



Systems Information Maize

Price		Production System Profit Probability from 4R					
Maize	Fertilizer	Irrigated		Rain-fed favorable		Rain-fed marginal	
		<$0	>$200	<$0	>$200	<$0	>$200
Low	Low	0.39	0.35	0.28	0.51	0.39	0.36
	Average	0.38	0.37	0.28	0.52	0.42	0.34
	High	0.38	0.38	0.28	0.53	0.45	0.32
Average	Low	0.40	0.40	0.28	0.58	0.37	0.44
	Average	0.39	0.42	0.28	0.57	0.39	0.42
	High	0.38	0.43	0.27	0.58	0.40	0.40
High	Low	0.40	0.45	0.28	0.60	0.36	0.49
	Average	0.40	0.45	0.28	0.61	0.37	0.48
	High	0.38	0.46	0.27	0.61	0.39	0.45

Oil Palm: Right Source, Place

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