



IFA CROSSROADS ASIA - PACIFIC 2007

Agronomic Workshop "Balanced fertilization in Asia: where are we?"

Micronutrients: Beyond Crossroads On the Highway!

Dr Kevin Moran
Director of Technical Services
Yara Phosyn Ltd

Essential Fertilizer Nutrients for Crops

PRIMARY NUTRIENTS	SECONDARY NUTRIENTS	MICRONUTRIENTS
Nitrogen (N) Phosphorus (P) Potassium (K)	Calcium (Ca) Magnesium (Mg) Sulphur (S)	Boron (B) Copper (Cu) Iron (Fe) Manganese (Mn) Molybdenum (Mo) Zinc (Zn)
100's Kg/Ha	10's Kg/Ha	1's Kg/Ha

1,000,000 atoms of N

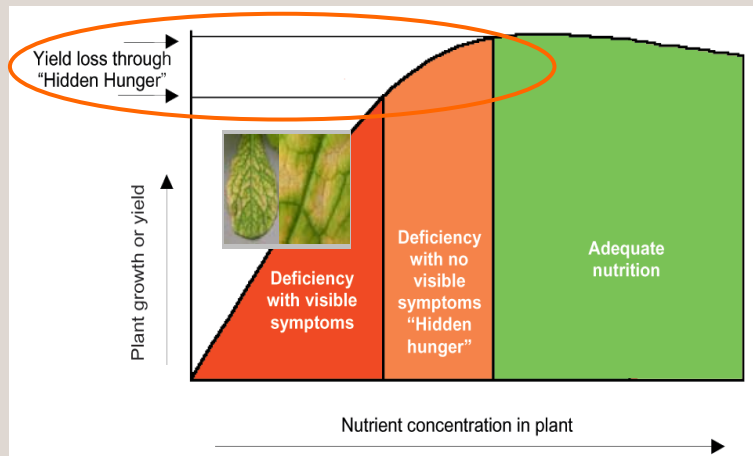
← impairs the biochemical advantages of (Katyal, 2004)

← Deficiency of 1 atom of Mo



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The Classic Nutrient Response Curve



The "Hidden Hunger" zone is where micronutrients will most significantly affect Crop Yields and Quality



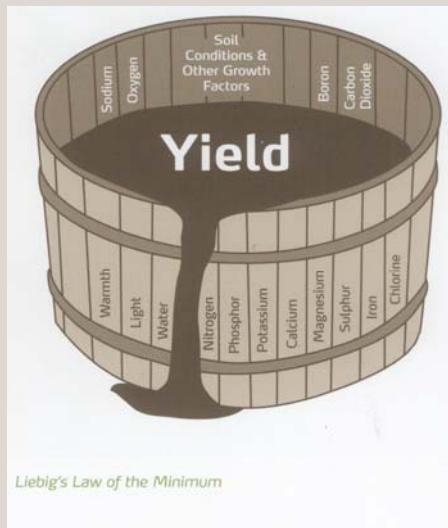
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Adequate and Balanced Fertilization with All Nutrients is Essential to Achieve Optimum Yield and Crop Quality

Justus von Liebig's "Law of the Minimum" published in 1843

'If one plant nutrient is deficient, plant growth is limited, even if all other vital nutrients are adequate...plant growth is improved by increasing the amount of the deficient nutrient'



"Although this 'law of minimum' was already detected in 1843, a shortfall of specific nutrients is still the major reason - with limited water supply - for low crop yields and poor quality throughout World Agriculture"

Dr Joachim Lammel, Director, Yara's Hanninghof Research Centre, Germany (2005)



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From "Barrel" to "Global" Scale

Agriculture Production and Resource Use

	1960	2000	2030-2040
Food production (Mt x10 ⁹)	1.8	3.5	5.5
Population (billions)	3	6	8 (/10)
Irrigated land (% of arable)	10	18	20
Cultivated land (hectares x10 ⁹)	1.3	1.5	1.8
Water-stressed countries	20	28	52
N fertilizer use (Tg/10 ¹² g)	10	88	120
P fertilizer use (Tg/10 ¹² g)	9	40	55-60

Pereira, 2003



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"Nutrient Mining" of Micronutrients with Increased Crop Production

Changes in land use China 1949-1996

	1949		1996		Change	
	Million ha	%	Million ha	%	In area million ha	%
Cultivated land	97.8	10.1	130.0	13.7	+32.2	+33
Orchards/plantations	1.1	0.1	10.0	1.1	+8.9	+840
Forest	125.0	13.2	227.6	23.9	+102.7	+82
Pasture	391.9	41.2	266.1	28.0	-125.9	-32
Settlements, industry/mining	4.7	0.5	24.1	2.5	+19.3	+40
Transport	2.0	0.2	5.5	0.6	+3.5	+173
Water area	22.5	2.4	42.3	4.5	+19.8	+88
Unused land	305.5	32.1	245.1	25.8	-60.5	-20
Total area	950.7	100.0	950.7	100.0		

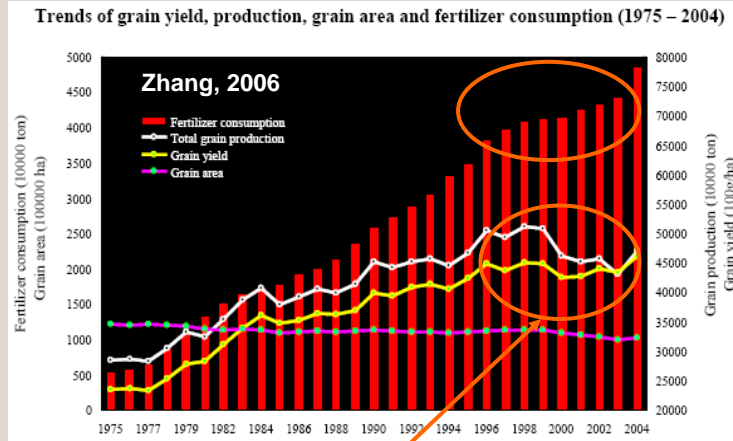
Hartemink, 2006



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“Nutrient Mining” of Micronutrients with Increased Crop Production



Note the recent “plateau” in grain yields relative to NPK fertilizer consumption



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“Nutrient Mining” of Micronutrients with Increased Crop Production

Percentage of soils with micronutrient deficiency in 1980s and recent in China (%)

Nutrient	1980s	Recent
Zn	51.1	60.7
B	34.5	25.3
Mn	21.3	20.1
Cu	6.9	10.6
Fe	5.0	20.5

Source: 2nd national soil survey and PPI/PPIC cooperative network

Jin, 2006

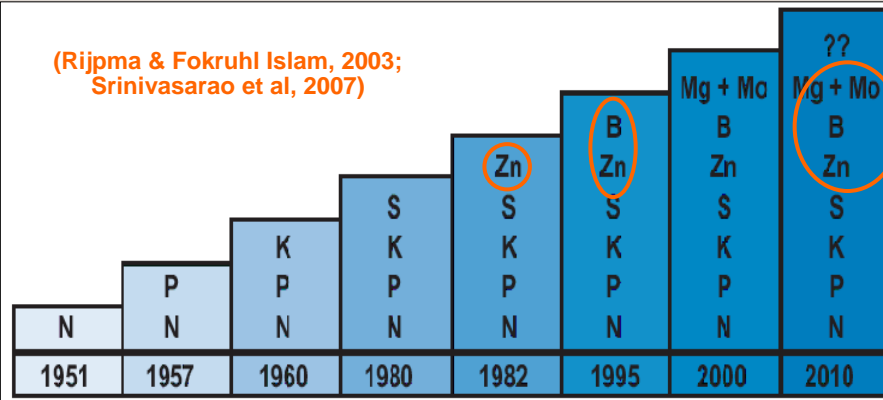


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"Nutrient Mining" of Micronutrients with Increased Crop Production

(Rijpma & Fokruhl Islam, 2003;
Srinivasarao et al, 2007)



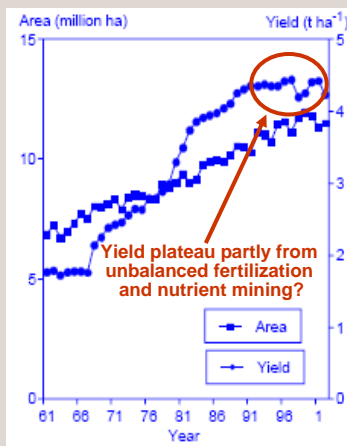
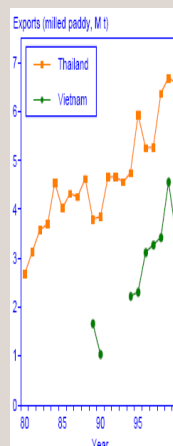
Future, sustainable agricultural production in the Asia-Pacific region now demands balanced micronutrient inputs to optimise crop yields and quality



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"Nutrient Mining" by Export (Fairhurst, 2003)



Future, sustainable agricultural production in the Asia-Pacific region now demands balanced micronutrient inputs to optimise crop yields and quality

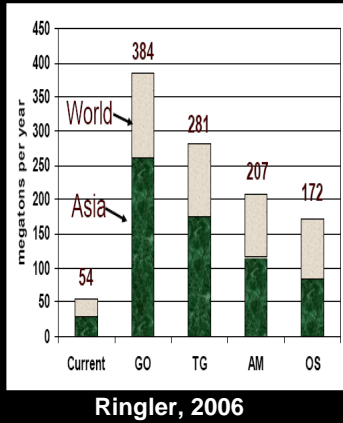


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Scenarios for Growth in Bio-Fuel Crops and Competition with Food Production

Projected Biofuel Production, Asia and Global, 2050

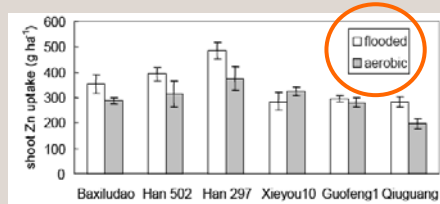


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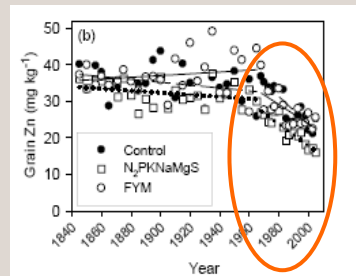


Cropping Practices and Newer Varieties can reduce Micronutrient Levels in Crops

Changes in Cropping Practices can have a profound affect on soil micronutrient availability to crops (Gao et al, 2007)



Modern, high harvest index crop varieties have lower micronutrient contents (McGrath et al, 2007)



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What could be the "Nutrient Mining" / Yield / Quality Loss Potentials in Indonesia without Balanced Micronutrient Inputs in the future?

Plantation /Field	'000 ha	Fruit	'000 ha	Vegetable	'000 ha
Rice-paddy	11801	Banana	280	Chilli	185
Oil palm	3600	Mango	165	Sweet potato	178
Maize	3504	Citrus	99	Cabbage	99
Coffee	894	Papaya	35	Onion	91
Sugarcane	435	Avocado	34	Potato	66
Cacao	360			Cucumber	48
Tobacco	167			Tomato	45
Total	20871		578		899

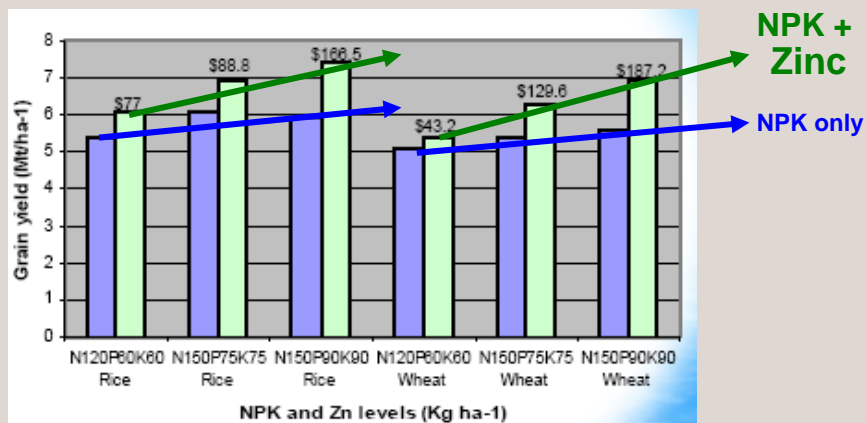
(Moore, 2007)



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Improved Primary Nutrient Use Efficiency (PNUE) of NPK application with Micronutrient Input...



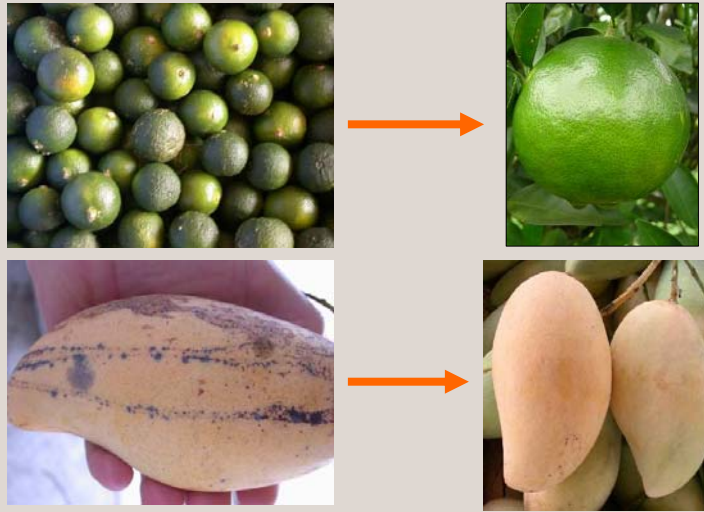
...in rice/wheat systems in Bangladesh (Phillips, 2006)



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Everyone's demanding Higher Quality...



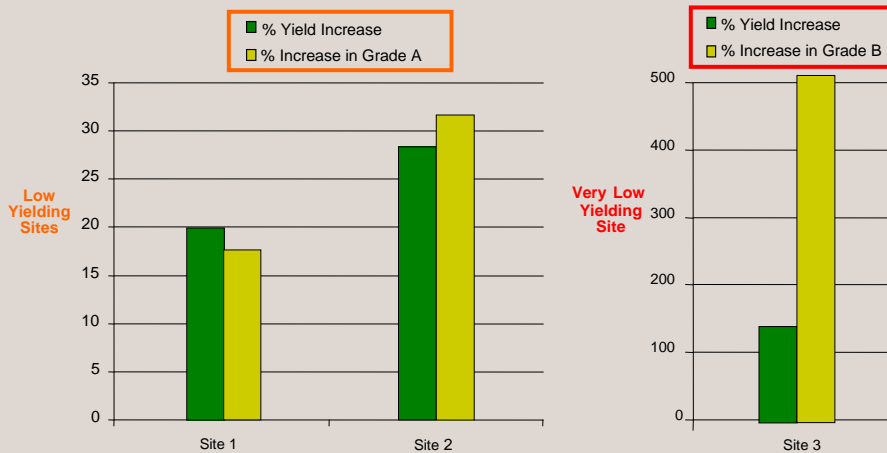
...and Micronutrients can make the Difference!



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Foliar Applied Micronutrients (*Tri-pholate™*) in addition to normal NPK inputs increase Mandarin Yield and Grade-Out in Indonesia



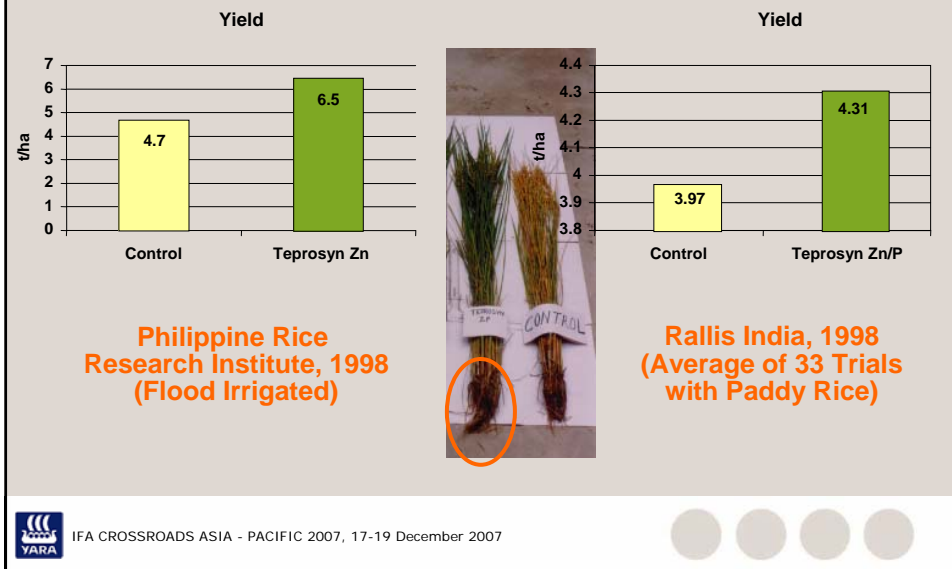
(Silalahi and Marpaung, 2007)



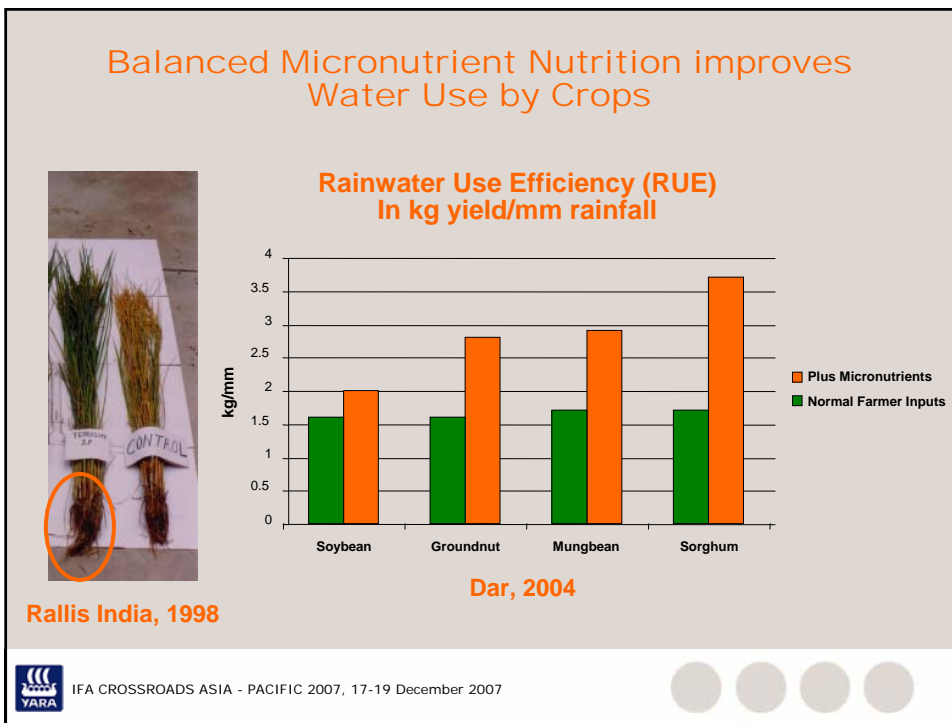
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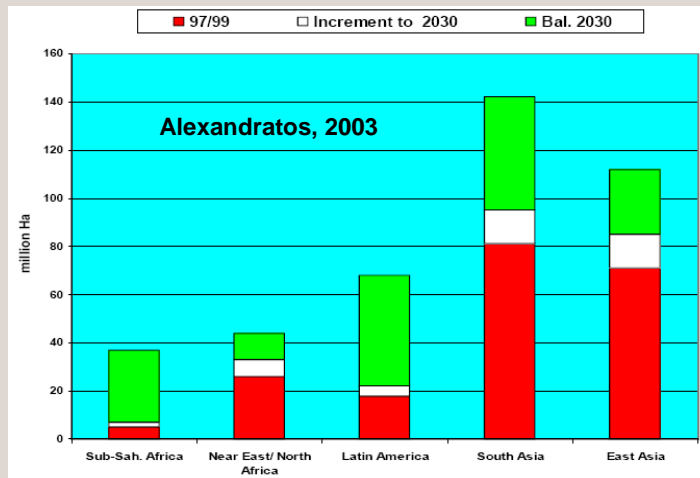
Balancing Micronutrients with Seed Treatments



Balanced Micronutrient Nutrition improves Water Use by Crops



Increase in Irrigated Area up to 2030



Irrigated crops are higher yielding and require more micronutrients



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Main Chelate Applications



Bugter and Zhang, 2006



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Food Quality and Human Health

Zinc in the national food supply
weighted mean per capita requirement based on absorbable zinc in food supply



Wuehler, Peerson, & Brown,

Crop fortification with micronutrient fertilizers...



...gives benefits from planting to table!



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Dealing with micronutrient deficiencies



Soil and Leaf Tissue Testing



YARA

REMOVE THE GUESSWORK

Megalab™



Effective Quality Treatments



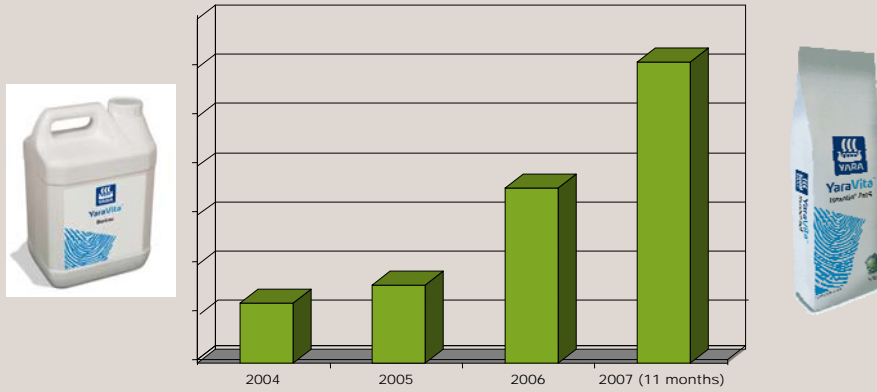
Computer and Field Advisor Interpretation



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Micronutrient Product Sales in S. E. Asia (million units)



Yara Phosyn Ltd - South East Asia, 2007



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You are now aware...
...so please don't let this happen to you!



THANKYOU



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