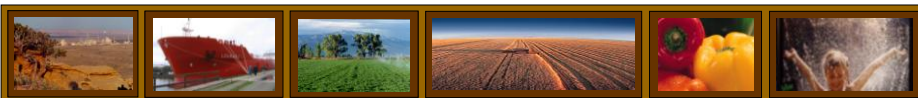




Bringing Earth's Resources to Life

Improving Nutrient (Phosphorus) Use Efficiency in Production Agriculture

Dr. Terry A. Tindall—World
Agronomist J.R. Simplot Co
Boise Idaho USA



Bringing Earth's Resources to Life

Phosphorus Nutrition is Essential to Feeding The Pacific Rim—And The World

- Vigorous plant growth depends on three essential nutrients contained on all package fertilizer such as 20-10-10—these stand for Nitrogen, Phosphorus and Potassium.
- None is more important than Phosphorus!



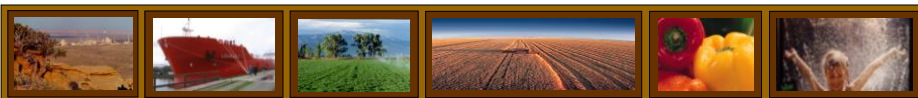


Bringing Earth's Resources to Life

Phosphorus Value

- Nitrogen is obtained from the air, but we have to mine P and K.
- Potassium is in abundant supply
- Phosphorus is different and world supply may diminish by the end of the century!

Simplot
AgriBusiness



Bringing Earth's Resources to Life

Phosphorus: A Crisis

- Mining Phosphorus for fertilizer is very limited and consuming P is being done more rapid than geologic replenishment!
- North American reserves are becoming very limited and world reserves are not much better.

Simplot
AgriBusiness



Bringing Earth's Resources to Life

Phosphorus Mining



Simplot
AgriBusiness



Bringing Earth's Resources to Life

Environmental Concerns

- Production goals need to be considered with environmental consequences.
- Excess Phosphorus in waterways helps feed algal blooms which starve fish of oxygen contributing to “dead zones”.

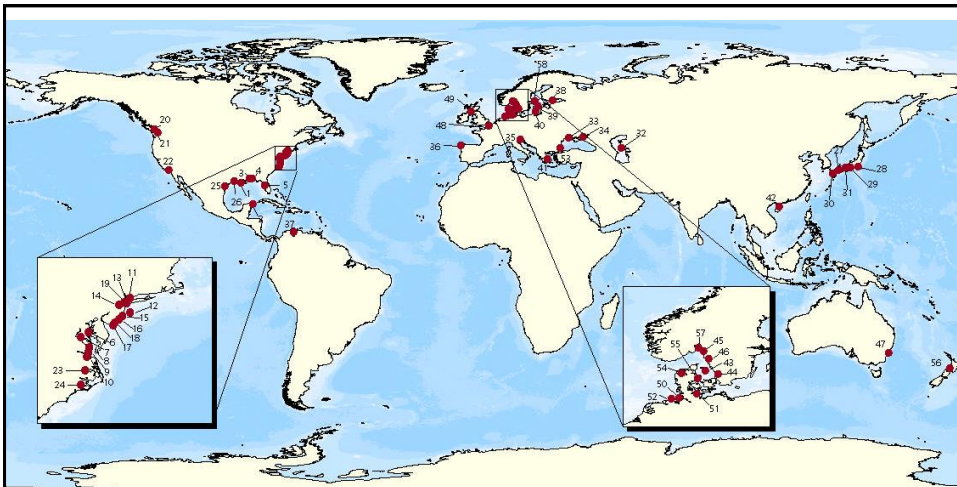
Simplot
AgriBusiness

Environmental Concerns

Bringing Earth's Resources to Life



Simplot
AgriBusiness



World Map of Hypoxic Zones

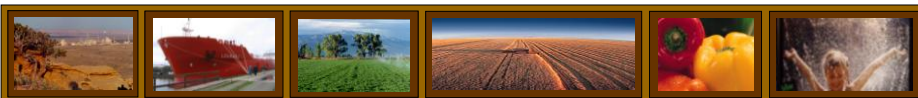
Simplot
AgriBusiness



Bringing Earth's Resources to Life

Best Management Practices for Production Agriculture

Simplot
AgriBusiness



Bringing Earth's Resources to Life

Best Management Practices

- Materials or technical inputs which maximize growers efficiency for improving crop yields and stewarding the soils in which they are produced.
- BMP Fertilizers—Best application timing, rates and sources of nutrient inputs.

Simplot
AgriBusiness

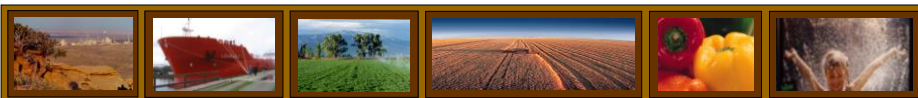


Bringing Earth's Resources to Life

Fertilizer Efficiency—N and P and other nutrients

The relationship between the amount of nutrient applied and relative yield combined with a growers net \$ return for that nutrient input

Simplot
AgriBusiness



Bringing Earth's Resources to Life

Fertilizer Efficiency Formulas— Agronomic Efficiency

- $(Y_n - Y_o) / F_n$ where Y_n and Y_o are the crop yields w and w/o the nutrient being tested, and F_n is the amount of nutrient applied.
- Nutrient Uptake = $(U_n - U_o) / F_n$, nutrient uptake w and w/o applied nutrient—apparent recovery—balanced approach good, but can be carelessly interpreted.

Simplot
AgriBusiness



Bringing Earth's Resources to Life

Fertilizer Efficiency—why now?

- Environmental considerations
- Crop Value
- FERTILIZER PRICES
- Limited P Resources



Bringing Earth's Resources to Life

Crop Values

Values of commodity crops are good and are expected to remain strong for the coming few years

Maize—
Rice—
Wheat—
Potatoes—
Soybeans—
Oil Palm--





Bringing Earth's Resources to Life

Fertilizer Prices

- Changing —the need has never been greater to make the most out of every unit applied.
- Phosphorus
- Nitrogen
- Potassium
- Sulfur—
- Micro-nutrients

Simplot
AgriBusiness



Bringing Earth's Resources to Life

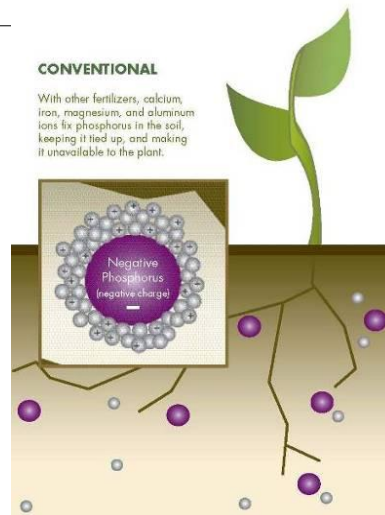
Why Is Phosphorus Fertilizer So Inefficient?

Forms insoluble precipitates of
Ca, Mg, Al or Fe making P
fertilizer unavailable

Simplot
AgriBusiness

Conventional Phosphate

- Root Interception
 - Phosphorus only gets into the plant when the root contacts the phosphorus



Simplot
AgriBusiness



Bringing Earth's Resources to Life

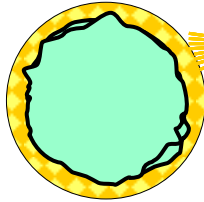
What Can be Done to Improve P Use Efficiency?

- Banding
- Starter
- In-Season
- Drip
- ADVANCED POLYMERS--Avail

Simplot
AgriBusiness

AVAIL[®] Phosphate Enhancer

Bringing Earth's Resources to Life



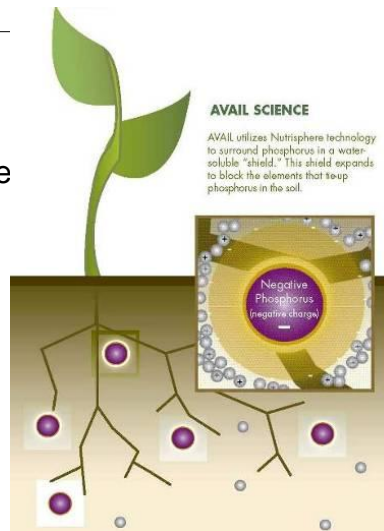
A polymer is applied to surface of dry P fertilizer or mixed with liquid fertilizer solutions



Simplot
AgriBusiness

Avail-Treated Phosphate

- Root Interception
 - Phosphorus only gets into the plant when the root contacts the phosphorus



Simplot
AgriBusiness

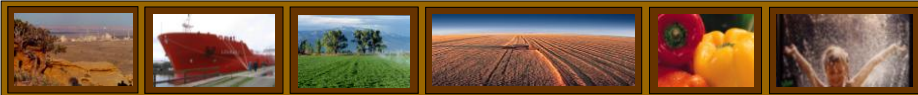


Bringing Earth's Resources to Life

Avail Mode of Action

- Di-carboxylic Acids--Maleic and Itaconic
- Highly Negative Charged materials (1800 meq/100 gms)
- Decrease crystalline structure negating precipitates being formed

Simplot
AgriBusiness



Bringing Earth's Resources to Life

Field Data

Excellent source of field research
to support applications

Simplot
AgriBusiness



Bringing Earth's Resources to Life

Field Crop Data Sets

- Maize
- Rice
- Potatoes
- Wheat



Avail / DAP – Corn **
 University of Minnesota
 Waseca, MN
 Contributor: Dr. Gyles Randall Ph.D.
 Soil pH: 7.3

	kg P ₂ O ₅ / ha	t/ha *	Gross Income Per ha @\$111.60/t	Avail Benefit Per ha
GSP – 18-46-0	28	10.9	\$1504.80	
18-46-0 + Avail (+ \$6.18/ha)	28	11.3	\$1564.50	+\$59.53 Grower b:c 9:1
GSP – 18-46-0	56	11.3	\$1563.90	
18-46-0 + Avail (+ \$10.08/ ha)	56	12.1	\$1664.20	+\$100.28 Grower b:c 9:1

*Note the efficiency factor of phosphate w/Avail (28kg vs. 56kg)
 _lsd @.10*

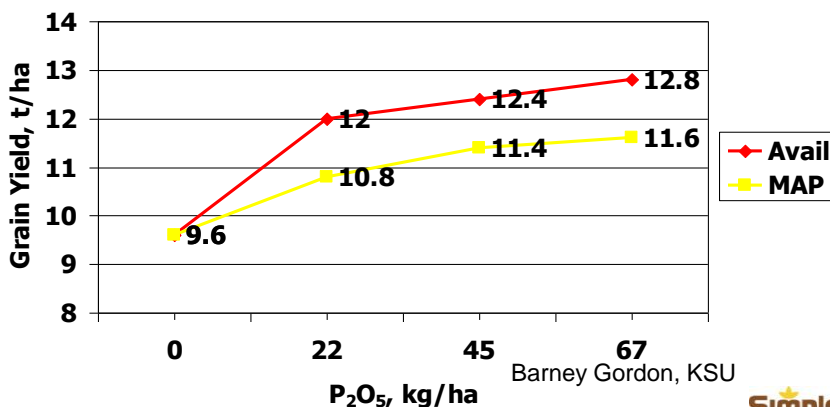
** Mean Composite of 3 year study at 56kg P₂O₅ rate: '02, '03, '04





Bringing Earth's Resources to Life

Avail Effects on Corn Grain Yield 2001-2003 Kansas



Barney Gordon, KSU

Simplot
AgriBusiness



Avail – Spring Barley – '07

University of Idaho

11-52-0 + Avail

Broadcast Applied - Preplant

Soil pH: 8.1 Soil P Conc. 21mg/kg

Values below: Mean levels of

0, 44, 90, 134 kg/ha P₂O₅ applications

	Phosphate plant Uptake gP/m ²	Yield t/ha	Gross Income/ha @ \$275.00/t	Avail Benefit \$/ha
GSP – 11-52-0	3.69	5.7	\$1567.50	
11-52-0 + Avail (+ \$19.80/ha)	4.33*	6.0	\$1650.00	+ \$82.50 (B:C = 4:1)

lsd p = .10

Dr. Jeff Stark **Simplot**
AgriBusiness



AVAIL On Winter Wheat Washington '07

Avail / MAP Banded Preplant

P2O5 kg/ha	Dry Matter at Heading kg/ha	Grain Yield t/ha	Grower Return/ha @ \$478.00/t
0	5824	3.42	
20 MAP	5936	3.36	
** 20 MAP + Avail	6832	3.76	+\$95.60

Soil pH: 6.0
P banded. Low soil test P.

Koenig, WSU

Isd yield p = < .10

**Avail Upcharge per Acre: +\$6.42

15:1 Grower b:c

27

Simplot
AgriBusiness



Avail – Potatoes '06-'07*

University of Wisconsin-Madison
Dry Phosphate applied at planting
6 trial Sites pH: 5.0 - 6.8
Soil P Levels: Low to Extremely High

	Marketable Yield t/ha	Specific Gravity	Gross Return / ha @ \$56.00/t	Avail Benefit/Acre + / -
GSP Phosphate @ 73 kg P ₂ O ₅	39.7	1.08	\$2,225.00	
Phosphate + Avail @ 73 kg P ₂ O ₅ (+\$16.06/A)	41.8	1.08	\$2,340.00	+\$98.94
GSP Phosphate @ 146 kg P ₂ O ₅	34.2	1.08	\$1915.20	
Phosphate + Avail @ 146 kg P ₂ O ₅ (+\$32.00/ha)	35.9	1.08	\$2010.04	+\$63.04

* 2 year mean used for data—R. Burbank

C. Laboski and M. Repking

Simplot
AgriBusiness



Bringing Earth's Resources to Life

ENHANCING P AVAILABILITY FOR RICE - Missouri

kg/ha	Uncoated	Avail Coated
0	6754 d	
28	7207 c	7560 ab
56	7510 bc	7610 ab
100	7762 a	7762 a

Soil pH = 6.8; Soil test P = 38 ppm Bray-1 Dunn, Univ. of Missouri
P source = TSP preplant



NSN / AVAIL – Upland Rice '08

Munoz, Nueva Ecija, Philippines

Phil Rice / Simplot USA

July to November 2008-wet season

Post plant fertilizer application

	Nitrogen - Phosphate /ha	% Nitrogen Efficiency	Yield / ha (tons)	Net Income / Ha (US)	AVAIL / NSN Cost to Benefit/ ha
GSP 14 -14 -14	90-28	39%	5.02	P38,249.00 (\$813.00)	
Urea + NSN 14-14-14 + AVAIL P305.68 (\$6.50)	60-15	78%	5.16	P39,621.00 (\$842.50)	+P1372.00 (+\$29.17) 4:1



Bringing Earth's Resources to Life

Summary

- Imperative that we promote P use efficiency
- Incorporate BMP's including 4 R's of Nutrient Management
- Avail Polymer Technologies Should be a Part of Growers Management Strategy

Simplot
AgriBusiness