



Latest R&D in the Product Development area...an International Perspective

Ron Olson
Worldwide R&D Manager
Cargill Crop Nutrition
soon to be "Mosaic"



New Products in the Market Now

- Polymer applications for Nitrogen – from Agrium and Simplot
- Stabilized Nitrogen – from Simplot, Ravensdown, & Agrotain International
- Steady Nitrogen Delivery – from Georgia Pacific
- Fertilizer Efficiency Material – from Specialty Fertilizer Products
- Organic Fertilizers – from IMC, United Environmental Services, Cargill Crop Nutrition
- Newly patented Fertilizer Product – from Cargill Crop Nutrition



Polymer Applications

- ESN Smart Nitrogen – Agrium
 - Slow-release N; environmentally friendly
 - Polymer coated urea (polyurethane)
 - Patented technology
 - N release rate governed by soil temperature, paralleling plant growth and nutrient demand
 - Assay – 44-0-0



Polymer Applications, cont.

- Polyon® - Simplot
 - Pursell Technologies polyurethane coating technology
 - Primarily for turf
- Trikote® - Simplot
 - Sulfur-coated urea
 - Polyon® coated



Stabilized Nitrogen

- Turf applications – Simplot
 - UMAX® and UFLEXX®
 - Urea fertilizers
 - Urease inhibitor – NBPT
 - Nitrification inhibitor – Dicyanamide
- Pasture applications – Ravensdown
 - Dicyanamide
- Cropping applications – Agrotain International
 - Urea fertilizers
 - Urease inhibitor – NBPT



Steady Nitrogen Delivery

- Nitamin™ – Georgia Pacific
 - Patented and patent pending technologies
 - Resin that steadily releases N as it is decomposed by soil bacteria
 - N delivery technology
 - Solid
 - Liquid



Fertilizer Efficiency Materials

- Specialty Fertilizer Products
 - Additives to increase fertilizer efficiency
 - Micronutrient preparations
 - Ammonium phosphates
 - DAP coated
 - MAP coated
 - 10-34-0 solution



Organic Potassium Fertilizer

- KMag Natural – IMC
 - Assay: 0-0-22, 22%S, 11%Mg
 - OMRI listed – approved for organic farming
 - Natural nutrients – not synthetic fertilizer
 - Nutrients are 100% water soluble
 - K
 - S
 - Mg



Organic Ammonium Sulfate

- Unified Environmental Services
 - Assay: 17-0.5-0, 19S
 - Ammonium Sulfate containing ~7-10% organic compounds
 - Prepared from
 - Anhydrous ammonia
 - Sulfuric acid
 - Biosolids



Ash from Turkey Litter

- Cargill Crop Nutrition
- Applied product in an Air Max 1000 at rates of 300, 600, 900 and 1200 lbs/acre



Newly patented Fertilizer Product

- MicroEssentials from Cargill Crop Nutrition - “Mosaic”



MicroEssentials MES15



MicroEssentials MES15

- Patent - has been approved by the USPTS and a US Patent number was issued in March of 2003: US6,544,313 B2

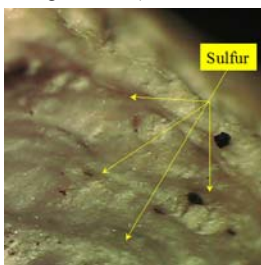
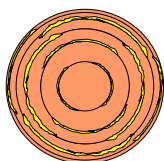


MicroEssentials MES15

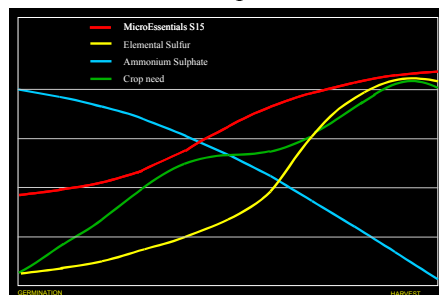
- Analysis: 13-33-0-15 S
- Components of each granule:
 - N: 47% NH_4^+ as ammonium sulfate (AS)
53% NH_4^+ as monoammonium phosphate (MAP)
 - P: 100% as monoammonium phosphate (MAP)
 - S: 50% as sulfate S (SO_4^{2-})
50% as elemental S (S^0)
- Patented US 6,544,313 B2



Microphotograph Cross Section of S15 Granule
(40x magnification)



MES 15 Response Curve



Soil pH / MES-15*

University of Manitoba

	<u>Sandy Soil</u>	<u>Clay Soil</u>
Check	6.0	8.0
MAP	5.0	7.3
S-15	4.6	7.1

Theory: Sulfur lowers the soil pH around the granule resulting in increased P uptake

* measured after 5 weeks



Uptake of Phosphorus*

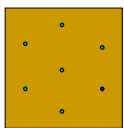
	<u>Sandy Soil</u>		<u>Clay Soil</u>	
	<u>Canola</u>	<u>Wheat</u>	<u>Canola</u>	<u>Wheat</u>
Check	27.0	26.4	20.3	22.3
MAP	45.4	48.4	54.8	47.1
MES15	60.6	50.7	61.8	51.0

*Mg/pot



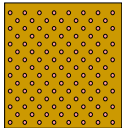
Sulfur Distribution in Broadcast Application

Typical blend



Sulfur as granules in bulk blend thru broadcast application (15 lb./acre)

MicroEssentials™ MES15



Sulfur incorporated in phosphate fertilizer (60 lbs./acre P₂O₅ and 15 lb./acre of sulfur)

Elemental sulfur is not very mobile in soil solution. When added as granules in bulk blends, much of their benefit is lost as plants must seek out the sparse sulfur granules across large areas. When incorporated in phosphate fertilizer, sulfur containing granules are uniformly distributed and readily available to plants.



MicroEssentials Replicated Research Trials 2003



Research Locations



Results for Corn

Treatment		Yield, Bu/A		
		North	Central	Avg
S15	13-33-0, 15S	136.3	168.2	153.5
ACT31C	11-36-0, 10S, 1Zn	136.4	169.4	154.1
ACT38	11-36-0, 12S, 2Zn	136.9	161.3	150.0
ACT37	12-34-0, 12S	137.8	159.0	149.2
ACT39	11-36-0, 11S	133.8	169.3	152.9
MAP		136.2	152.9	145.1
MAP + AS		131.8	157.5	145.6
DAP		133.3	158.4	146.8
DAP + AS		132.9	158.9	146.9



Alfalfa Research Results

Alfalfa		Yield
Treatment	Formulation	Ton/A
		Average
Check		2.92
K2O Check	KCl only	2.84
S15	13-33-0, 15S	3.14
ACT33	10-37-0, 0.5B	3.35



Results for Canola-2003

Treatment	Canola	Yield, Lb/A
		Avg
S15	13-33-0, 15S	1433.4
MAP		1283.2
MAP + AS		1357.4
MAP + AS + S		1358.9
AS+S		1327.5



Winter Wheat Research Results

Treatment	Formulation	Yield, Lb/A
		Average
S15	13-33-0, 15S	78.0
MAP	11-52-0	69.5
MAP + AS	11-52-0 + 21-0-0- 24S	65.8
ACT 28 B	11-47-0 + 1%Cu	65.5
ACT 32	11-36-0-10%S + 1%Cu	81.6
ACT 37	12-34-0-12%S	83.7



Results for Spring Wheat

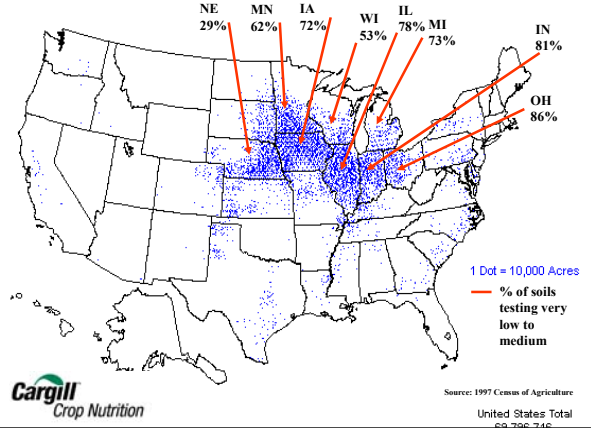
Treatment	Formulation	Yield, Bu/A
		Avg
S15	13-33-0, 15S	36.7
ACT28B	11-47-0, 1Cu	37.3
ACT32	10-36-0, 10S, 1Cu	35.3
ACT37	12-34-0, 12S	36.7
MAP		33.9
MAP + AS		33.5



A New MicroEssentials Product for Corn

ME SZ

Corn for Grain or Seed: 1997

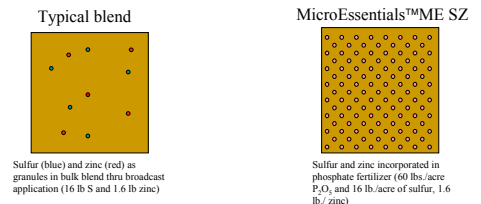


Analysis: 12-39-0-11S-1Zn

- Components of each granule:
 - N: 40% NH₄⁺ as ammonium sulfate (AS)
 - 60% NH₄⁺ as monoammonium phosphate (MAP)
 - P: 100% as monoammonium phosphate (MAP)
 - Zn: 100% sulfonated zinc oxide
 - S: 50% as sulfate S (SO₄⁻)
 - 50% as elemental S



Sulfur & Zinc Distribution in Broadcast Application



Elemental sulfur and zinc are not very mobile in soil solution. When added as granules in bulk blends, much of their benefit is lost as plants must seek out the sparse sulfur/zinc granules across large areas. When incorporated in phosphate fertilizer, sulfur/zinc containing granules are uniformly distributed and readily available to plants.



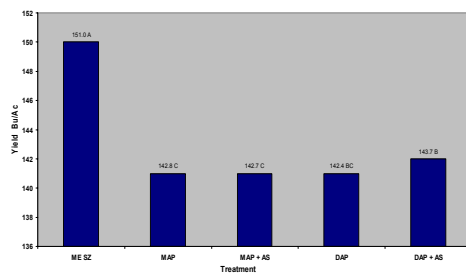
Cargill Crop Nutrition Corn Fertility Trials 2002/2003

- Summary across years
- ME SZ had significantly better yields than MAP, MAP + AS, DAP, and DAP + AS.



COMBINED CORN FERTILITY 02-03 Summary Data for 21 Trials

Cargill Crop Nutrition
95% Probability
Student-Newman-Kuels



ME SZ 2002/2003 Results across all Locations

Corn		Yield, bu/A
Treatment	Formulation	Average
ME SZ	12-39-0, 11S, 1Zn	151.0
MAP	11-52-0	142.8
MAP + AS	11-52-0 + 21-0-0 24S	142.7
DAP	18-46-0	142.4
DAP + AS	18-46-0 + 21-0-0 24S	143.7



MicroEssentials ME SZ

- Patent Status – this new product is produced under Cargill's exclusive patented process. There is no other fertilizer product like this available in the world today.