



ARCTIC S 11-0-0 WITH 75% SULPHUR

Sulphur Made Easy

www.northernnutrients.com

What is Arctic S- Mission statement

Arctic S is a 75% micronized elemental Sulphur, low salt fertilizer that can be used as a source of all or some of a growers Sulphur demands.



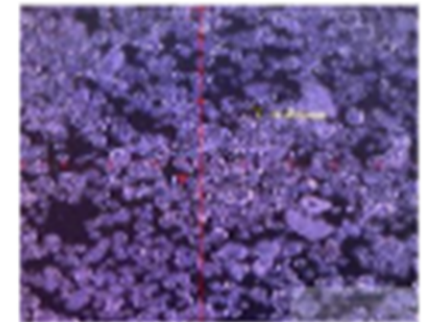
History of 11-0-0-75

- Developed by Shell, first factory built in Korea
- From 2018 until 2021 imported by NN into North America
- April of 2022 Northern Nutrients commissioned own factory
- 5 full years on the market in Western Canada with an estimated 2 million acres used in 2023 between W. Can & the PNW.



WHAT IS THIOGRO UREA-ES/SPECIAL-S TECHNOLOGY?

UREA-ES/SPECIAL-S IS A SHELL THIOGRO PATENTED TECHNOLOGY IN WHICH MICRONIZED ELEMENTAL SULPHUR IS EVENLY DISPERSED AND EMULSIFIED IN A UREA MATRIX USING A PROPRIETARY HIGH SHEAR DISPERSION UNIT AND A PROPRIETARY ADDITIVE.



SPECIAL-S IS A HIGH SULPHUR UREA-ES PRODUCT, MADE EXCLUSIVELY ON AN IPCO ROTOFORMER® CONTAINING ~75% MICRONISED SULPHUR IN A MATRIX OF UREA.

Solubility is Key

- Urea base with Micronized particle size allows for quick breakdown & conversion from elemental S to plant available S04
- Allows for in row application where traditionally elemental Sulphur's required spreading applications to oxidize where Arctic S can be seed row and side band placed



ARCTIC-S DISOLUTION/DISPERSION

Dispersion mechanism involves urea dissolving in water leaving clusters of sulphur particles which then 'crumble'

Timeframe: minutes (3-5)

SULPHUR BENTONITE SWELLING/DISPERSION

Dispersion mechanism consist of the swelling clay expand, breaking the solid elemental sulphur matrix in small pieces

Timeframe: hours (24-48)

TECHNICAL FEATURES

Analysis:

11% Nitrogen

75% Elemental Sulphur

Arctic S Salt index of 17.8

Ammonium sulphate: 68.3

Ammonium thiosulphate: 90.4

Physical Properties	Sample		
	Urea Pastilles	Super-S	Sulphur Pastille
Crushing Strength (Average*, kg/pastille)	1.46	3.48	2.31
Crushing Strength (Range*, kg/pastille)	0.90 – 2.05	1.05 – 6.35	1.60 – 3.10
Abrasion Resistance (% degradation)	1.31	1.94	4.25
Impact Resistance (% shattered pastilles)	0.44	1.14	16.23

+ APPLICATION FEATURES

Blends well with most conventional dry fertilizer

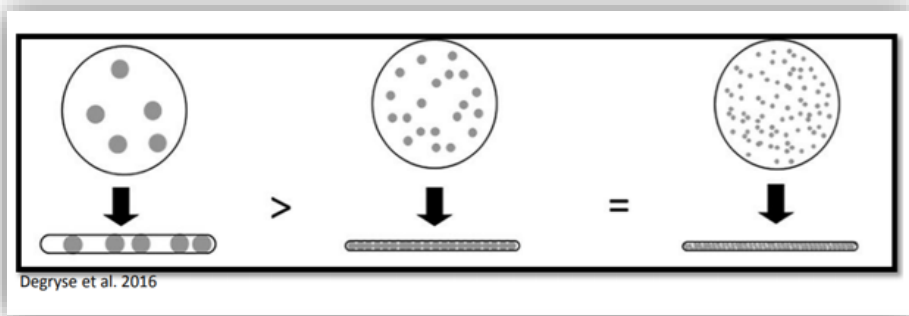
SGN : 300

Bulk Density : 62.5 lbs/ft³

Angle of Repose : 32 Low

Salt Index : 17.8

TECHNICAL FEATURES



Particle Size (microns)	% S Oxidized	
	2 Weeks	4 Weeks
> 2,000	1	2
840 – 2,000	2	5
420 – 840	5	14
180 – 420	15	36
125 – 180	36	68
90 – 125	61	81
60	80	82

Canola.okstate.edu

	Micron Size Average
Arctic S	30-40um
Sulphur 90	200-300um
Human Hair	80um

Particle size is key to the transition to sulphate

Conversion rates are subject to the environmental and soil conditions



Low salt index for safer seed placement
eliminating or reducing chances of seed burn



Less plugging/caking of drills and floaters in humid
conditions



Save time & money with less product to handle.
1/3 to 1/2 the product to handle

Benefits Compared to Ammonium Sulphate Pt 1



Improved soil health & biological activity especially with repeated applications as thiobacillus and other soil health factors improve



Improved uptake of Phosphate by reducing P tie up in high PH or calcium rich soils



Lower acidity vs Ammonium sulphate prevents PH decreases and Mn toxicity



Provides a season long source of Sulphur with reduced leaching, beneficial in wet conditions

Benefits Compared to Ammonium Sulphate Pt2



More flexibility in blends without the worry of caking



Less storage space required for retailers freeing up bin space for other products



Better product availability in season with high-capacity plant in Saskatoon compared to AMS which is reliant on domestic and imported product

Benefits Compared to Ammonium Sulphate Pt 3



High availability and efficiency of Arctic S technology often outweigh the added benefits of lower cost Sulphur bentonite



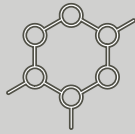
Safest high elemental product on the market

- Self extinguishing material
- Dust levels below minimum explosion levels of elemental



Can be blended easily with other products and soil applied (oxidization in soil)

Benefits compared to Sulphur bentonite 90



Phosphate prills are often slow to breakdown resulting in the Sulphur portion being unavailable as well, compared to the urea based Arctic S prills which dissolve quickly



Customizable blend of MAP + Arctic S where P+S are in a fixed ration, often requiring Sulphur top ups for Canola

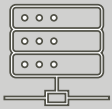


Often a blend of Arctic S + MAP can be 100/ton discount to P+S single prills

Benefits compared to Phosphate + Sulphur fertilizers



CaSO₄ can lead to decreased phosphate availability in high PH soils



Independent trials in Saskatchewan trials showed limited impact of CaSO₄ even in low PH soils



Improved biological activity of Arctic S may outweigh any calcium benefit of CaSO₄ or Arctic S can be used in conjunction with CaSO₄ sources

Benefits compared to Calcium Sulphate fertilizers



SAFETY FEATURES

Non-Hazardous Fertilizer as per OSHA

Strong prills create a fraction of the dust compared to Sulphur bentonite that test at a fraction of minimum explosion limits

Self extinguishing material- Class 3 compared to Sulphur bentonite which is Class 5 which mitigates fire risk

Dust Hazard analysis available upon request

Safety Part Two

- Recent fires and explosions with S85 & S90 have insurance companies restricting or considering restrictions on Sulphur bentonite products
- 1.7 Million Lb. of Sulfur Burns in Fire at Nutrien Fertilizer Plant | powderbulksolids.com (March '22)
- Fire destroys Wilbur-Ellis fertilizer plant | Columbia Basin Herald (October '22)
- Sulphur explosion forces temporary evacuation of several homes in MacGregor: Manitoba RCMP | CBC News (August '23)



A fire was reported shortly after 1 p.m. Monday, Feb. 28, 2022 at Nutrien Ag Solutions in Sunnyside, Wash. No one was injured and at least one building was destroyed.



A small fire at Shur-Gro Farming Services in MacGregor, Man., was quickly contained by about 12 firefighters on Tuesday afternoon, according to Chris Leckie, chief of the MacGregor fire department. (Walther Bernal/CBC)



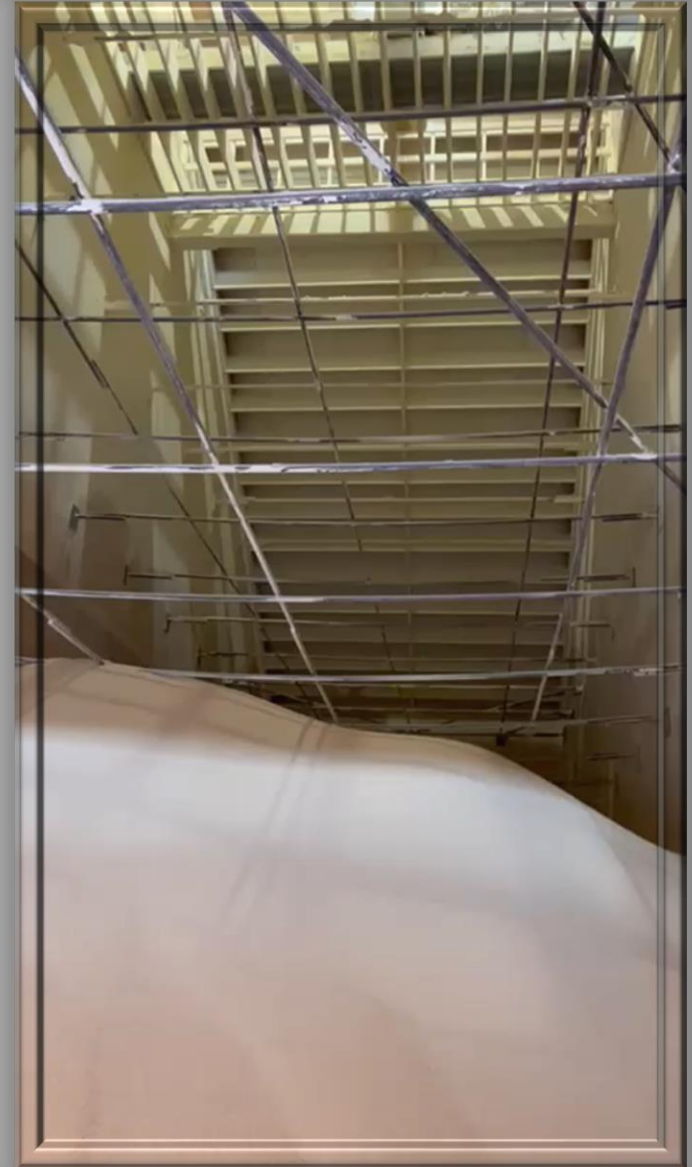
ARCTIC HANDLING

ARCTIC 

EXCELLENT FOR BLENDS

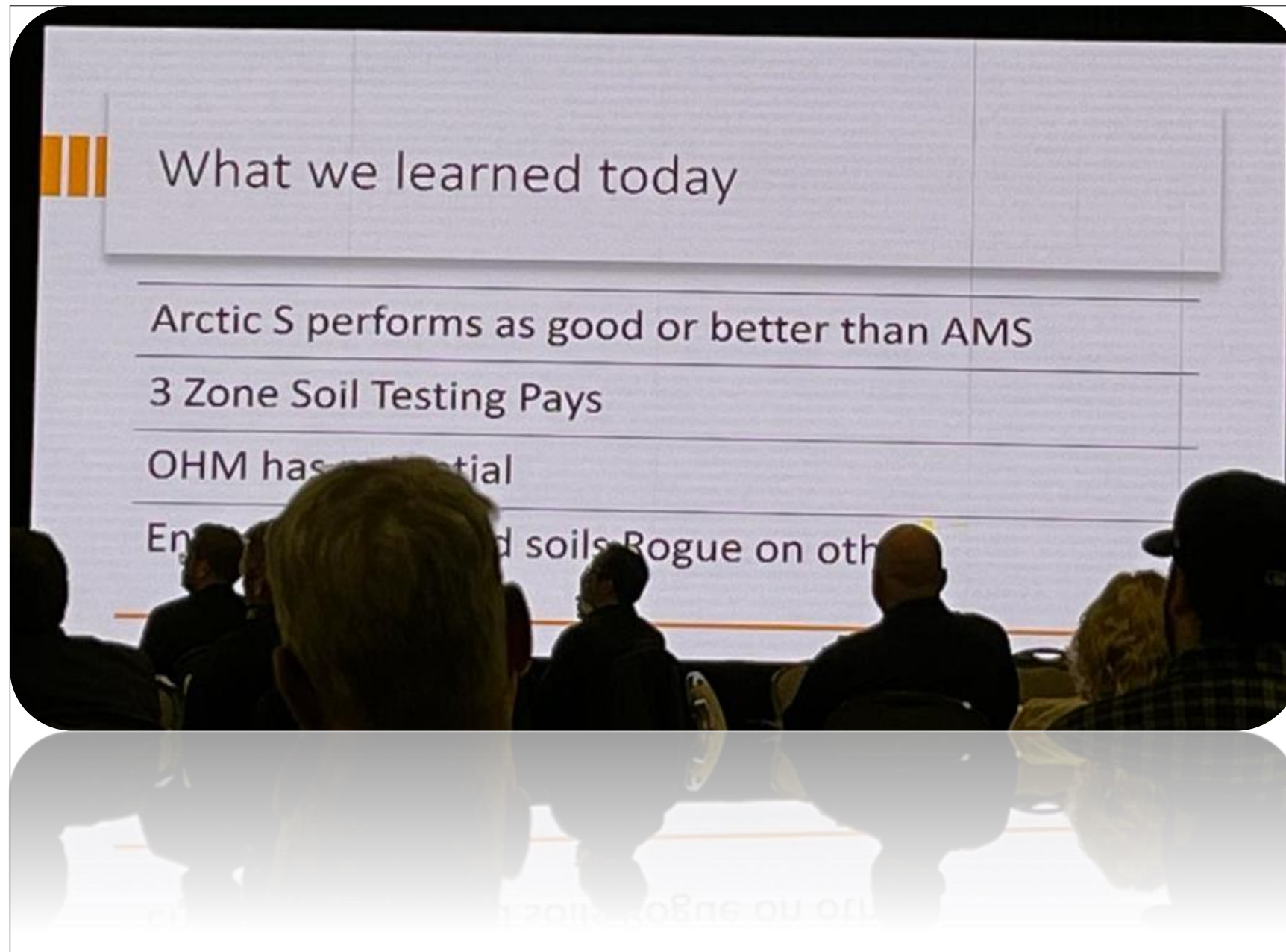


AUGUST 2023 PRODUCTION



Agronomy- Arctic S can be as efficient or more efficient than Ammonium Sulphate

- UMYI – Possibly the most respected independent trial studies in Western Canada
- 3 locations in 2022 in different soil PH's and multiple application rates
- Arctic S outyielded or was equal to AMS across all sites



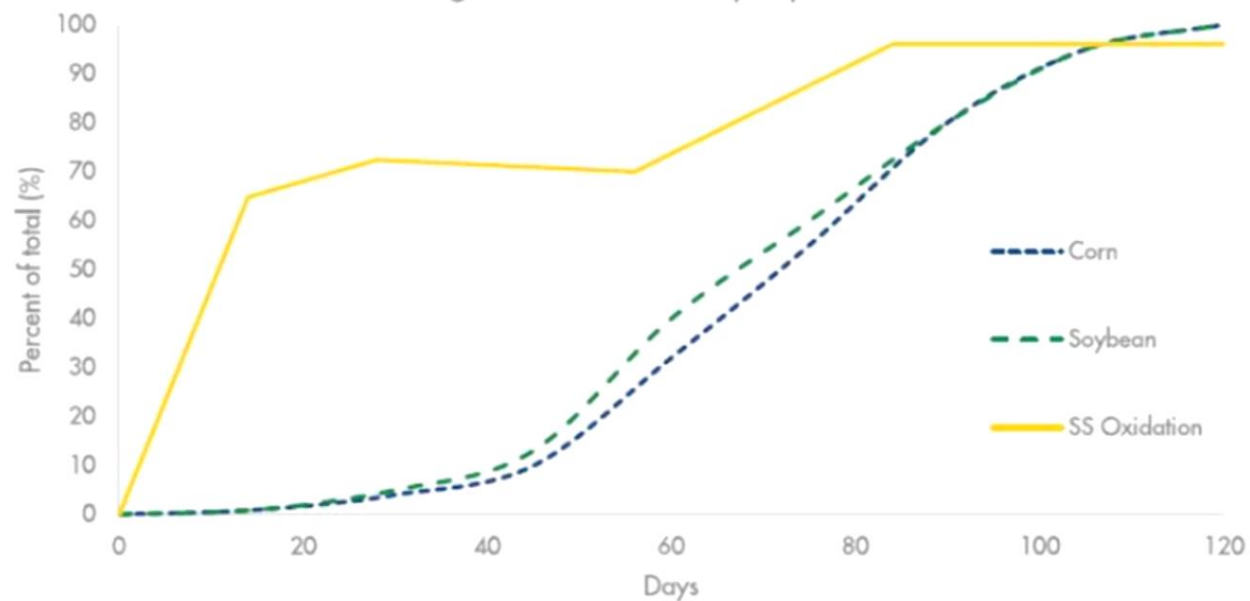
CIRRUS TRIALS 2018 – SPECIAL-S OXIDATION (Probe Test)

By applying elemental Sulphur in Micronized form, growers can access the in season availability of a Sulphate product while reducing the risk of losses through leaching.

Delivering Sulphur when your crops needs it most ensures you see a return on your fertilizer investment!

Special-S Oxidation Compared with Crop Need

Measured Using PRS Probes, Crop Uptake Source IPNI

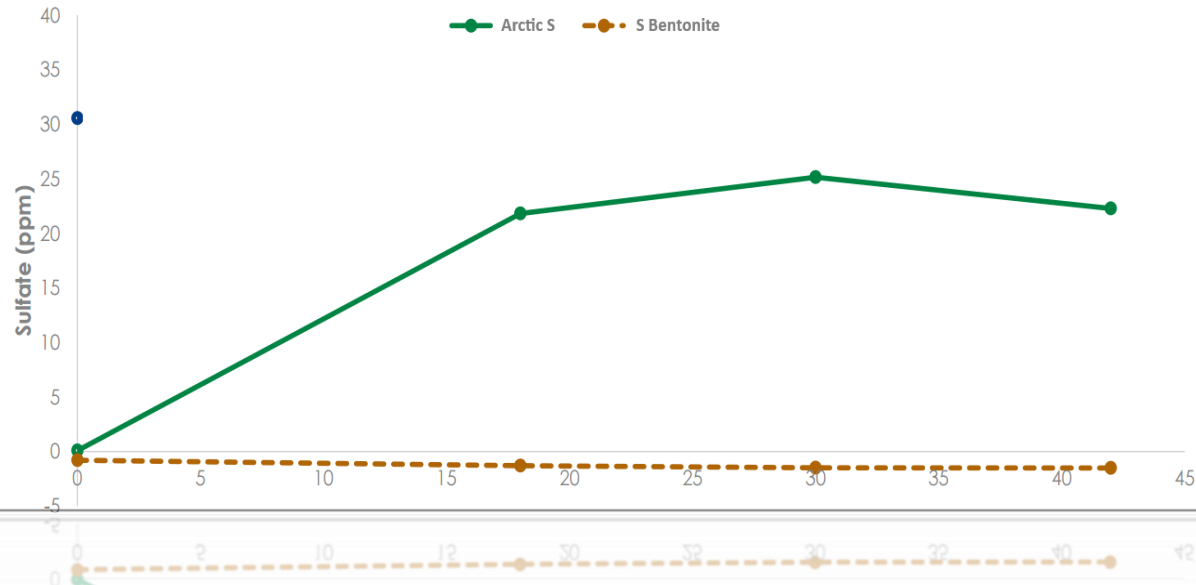


Oxidation test conducted in controlled environment to determine maximum oxidation potential of Special-S. Variable climatic conditions in first 40 days would likely show Special-S availability closer to uptake curves.



OXIDATION TRIALS SHOW THAT ARCTIC-S HAS FASTER AVAILABILITY THAN SULPHUR BENTONITE WHILE PROTECTING AGAINST SULPHATE LOSSES

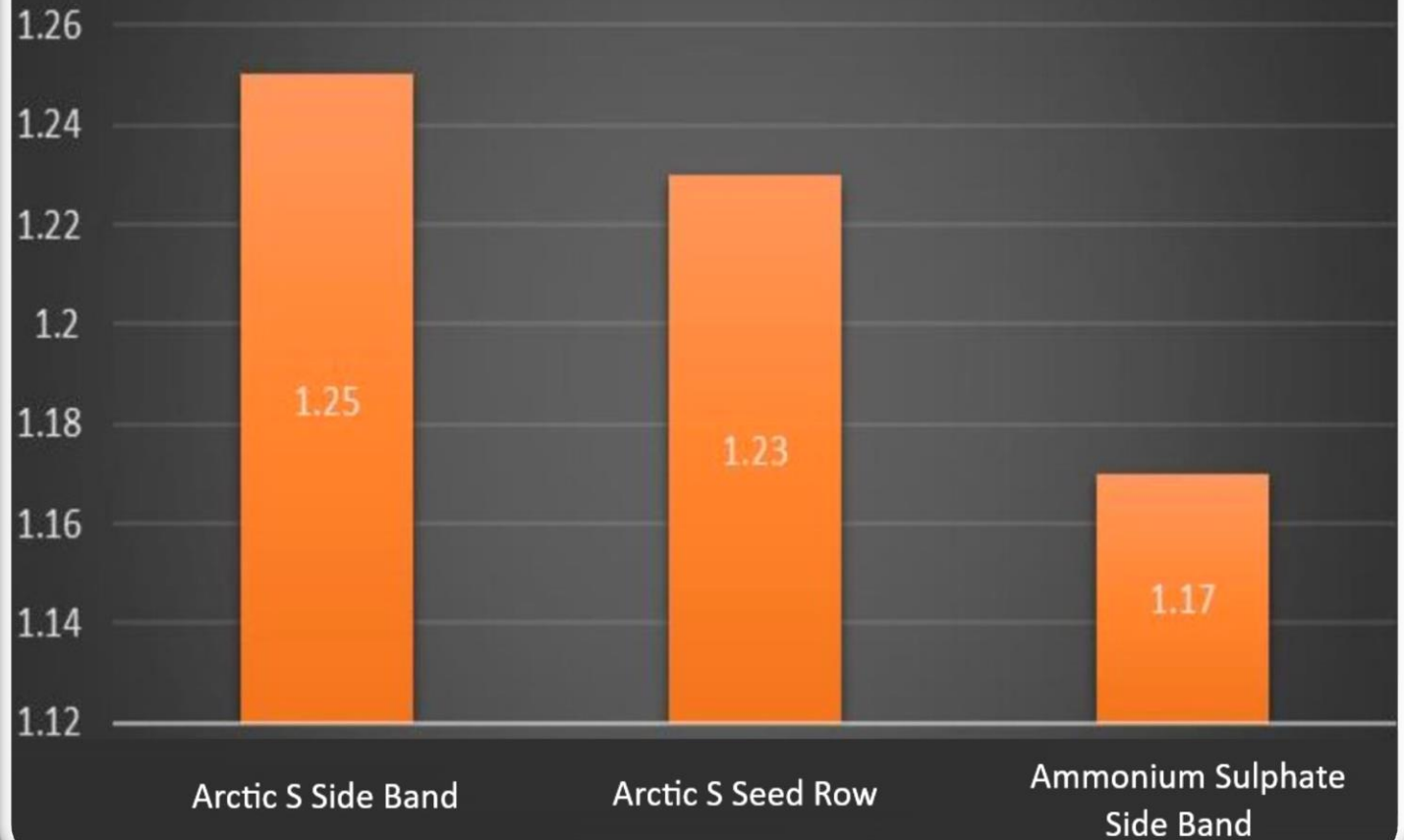
Sulfur Oxidation Tennessee
(Control Plot S Removed)



ARCTIC S
COMPARED
TO SULFATE
BENTONITE

TISSUE RESULTS ICMS TRIALS 2018 SASKATOON

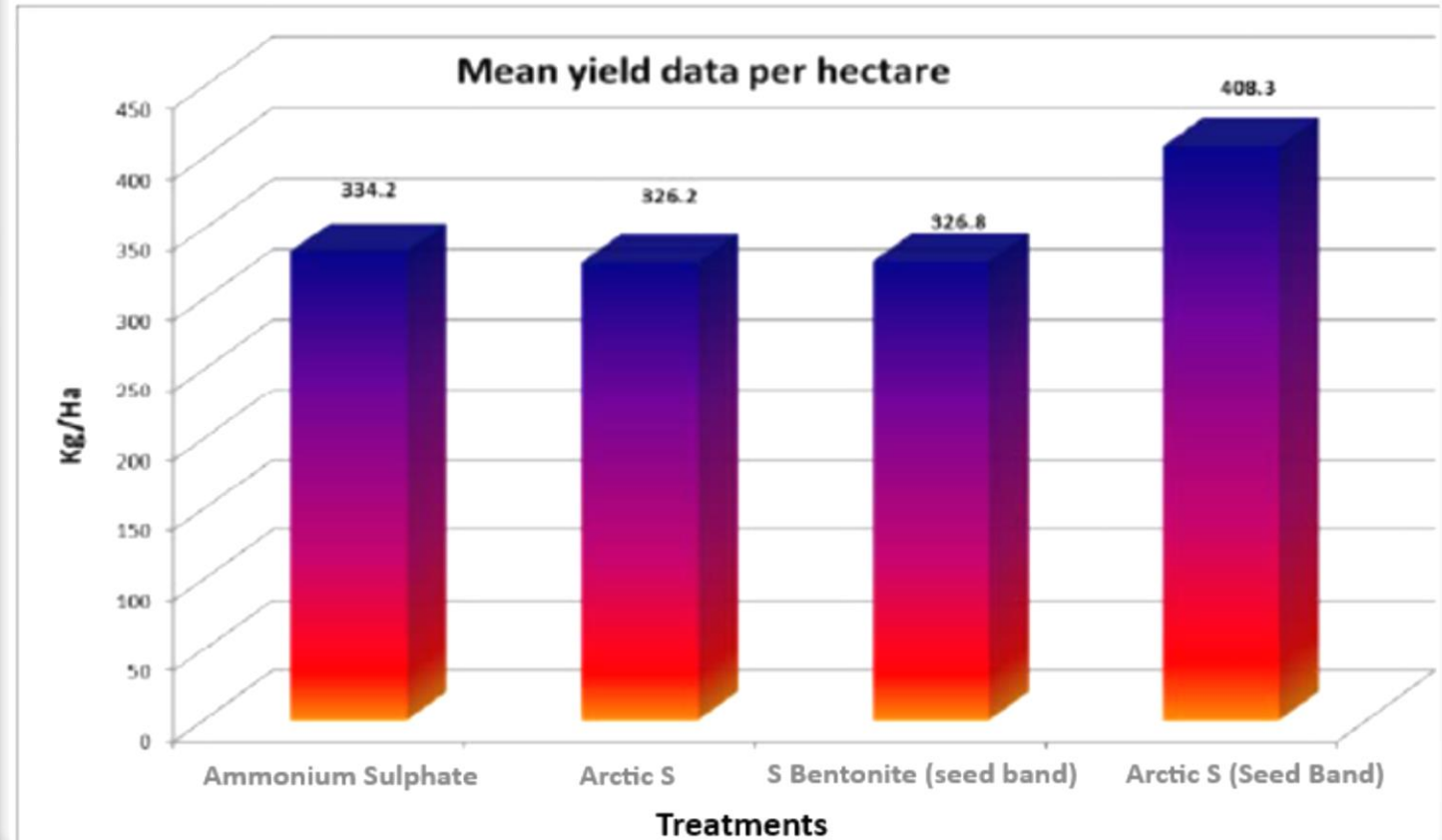
Tissue Test %S





CANOLA YIELD TRIALS 2019 AUSTRALIA

Eurofins Agrosience Services Summary of Results - Corowa, NSW Mean Canola Yield (kg/ha)

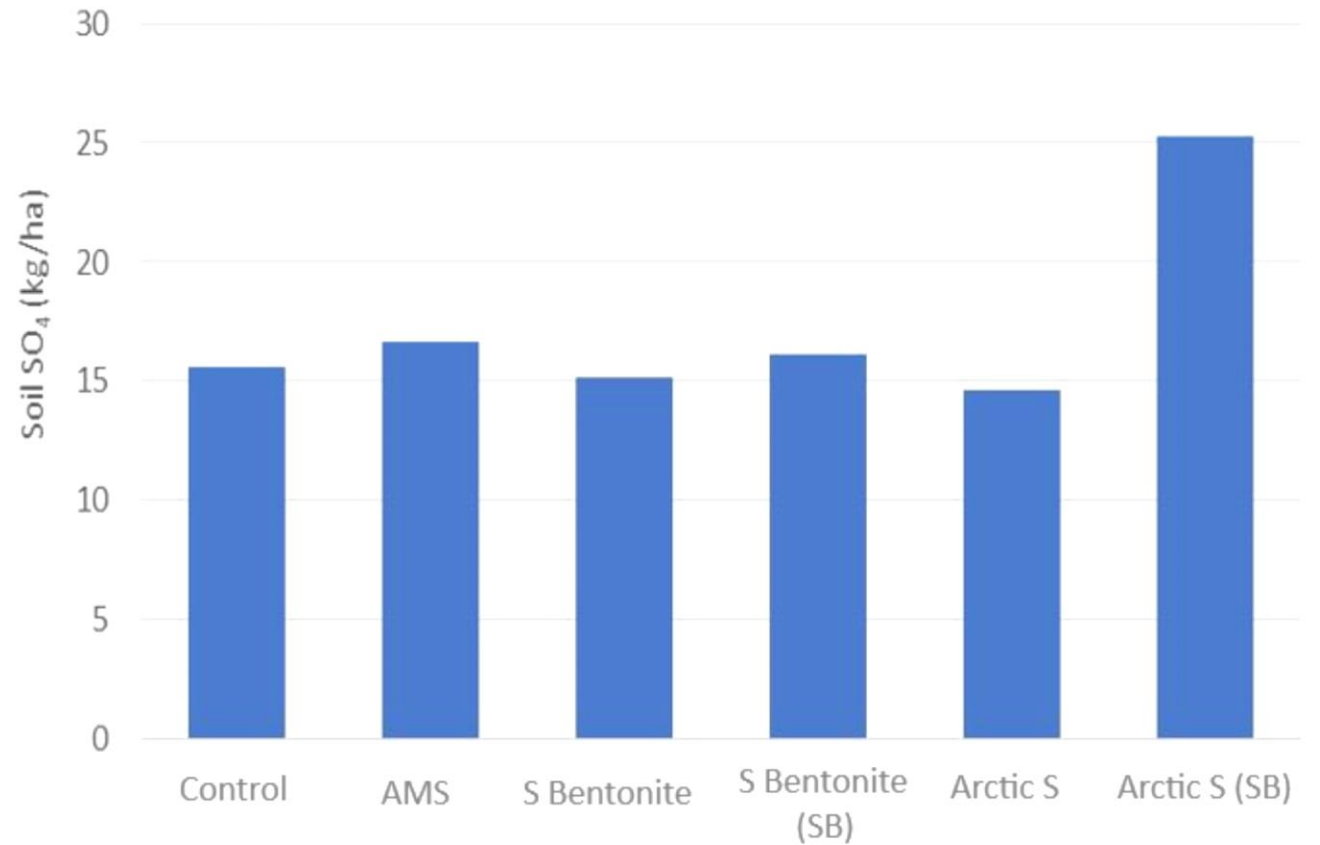


YIELD TRIALS 2018

SWIFT CURRENT

Final Soil SO₄

Swift Current, SK



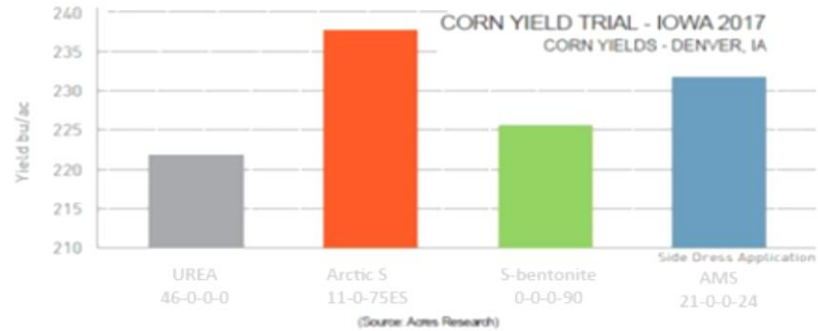


CORN YIELD TRIALS 2017 IOWA, USA

4

Increases Crop Yields

Continuous Sulphur supply increases crop yield



Soil Type : Loamy Fine Sand

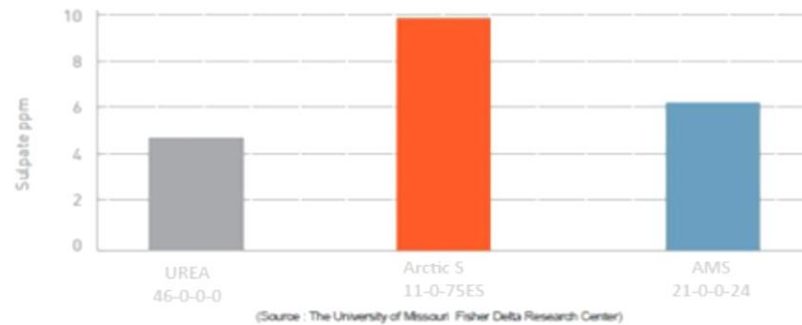
Treatments tested provide Sulphur requirement to crop. N,P,K and S rate were applied uniformly for all treatments and at the recommended rates for the region, the exception being a control treatment with no S/Urea.

5

High Levels Of Residual Soil Sulphate After Harvest

Arctic S - Economical and Sustainable

Residual soil Sulphate levels post harvest combined with comparable yield results suggest sufficient oxidation for Super-S within the growing season, while offering residual benefits for future crops.



RESIDUAL SOIL SULPHATE levels POST HARVEST
(Plant Sulphur Uptake Not Included)



CUSTOMERS' EXPERIENCE

Retailer in Northern Saskatchewan Spring 2023

- Used 1000 tons of Arctic S as a cold turkey replacement to Ammonium sulphate, on over 80,000 acres
- Enjoyed only needing a single 160mt bin for Sulphur and the ability to have product available on a few hours' notice
- Retailer set up dozens of side by sides vs Ammonium sulphate
- Arctic S was consistently darker green cabbage with more cabbage mass
- Customer reordered 1,000mt in summer fill of 2023

**Farmer photo with 4 inches of rain and first year use of Arctic S*



Grower in Northern Saskatchewan Spring 2023

- 3rd year of using Arctic S
- Enjoys using 1/3 the product compared to AMS
- Believes the repeated use of Arctic S has led to improved yields compared to Ammonium sulphate users in his area with similar land and rainfall



Grower in Southern Saskatchewan Spring 2021

1st year applying elemental Sulphur, noticed product breaking down within minutes of application in the seed row in very dry conditions

lol

Today 2:47 PM



That sulphur is paste 10min after hitting the ground

When & How to use Arctic S?

- Replacing fields with previous application history of elemental
- Replacing ammonium sulphate fields with adequate fertilization history
- Spring Blended or broadcast with Urea, phosphate, potash as your sole source of Sulphur
- Blended with S15, 40 Rock, or Polar 42 for two forms of Sulphur or top up your Sulphur for high Sulphur using crops
- Blended with Ammonium sulphate or Amidas
- Strategies to implement from retailers over the last 4 years include:
 - Cold turkey switches from AMS in spring blends
 - First year all Sulphur in pulses in cereals with Arctic S and most of canola blends from Arctic S
 - Fall spreading annually with Super U or other Nitrogen for all crops
 - In season top dress alone, with Urea or with Urea and AMS

When to consider a supplemental form of S with Arctic S?

- Field with zero residual Sulphur due to under application, for example Manitoba fields often apply only 12-15lbs during the canola rotation and no Sulphur in other rotations resulting in a major deficit of Sulphur over time. We would recommend supplementing with ammonium sulphate or ensuring a sufficient application rate of 30lbs/acre of Sulphur or higher and not in the mid row band in these conditions
- Fields with no fertilization history such as a converted hayfield
- Mid row banding any nutrients can result in nutrient deficiencies, application is recommended as broadcast, seed row, sideband

Pricing

- Arctic S + Ammonia typically lower cost than Ammonium Sulphate
- Arctic S + Urea typically equal cost to Ammonium Sulphate
- Arctic S + MAP typically significantly less cost than P+S single prill products

TESTIMONIALS

“WE ARE NOW ON OUR FIFTH SEASON OF USING ARCTICS. THE LOW SALT INDEX AND HIGH S CONTENT ARE A PERFECT FIT FOR OUR GROWERS” ~ *MATT OWENS, EMERGE AG*

“WE LIKED HANDLING LESS PRODUCT & OUR CANOLA IS PROBABLY THE BEST WE HAVE EVER SEEN ON THE FARM” ~ *BRANDON SUNDQUIST, WATROUS, SK*

“WE HAD A CUSTOMER WHOSE AMS BLENDS WERE CAUSING TROUBLES IN HIS DRILL THIS SPRING. AFTER SWITCHING HIS BLEND OVER TO ARCTICS, ALL THE PROBLEMS WENT AWAY”
~ *SASKATCHEWAN RETAILER*



THANK YOU

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