World Fertilizer Trends & Supply
and
Potassium Research Updates

Leanna Leverich Nigon
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Director of Agronomy | The Fertilizer Institute

Part I: World Fertilizer Markets

Leanna Leverich Nigon

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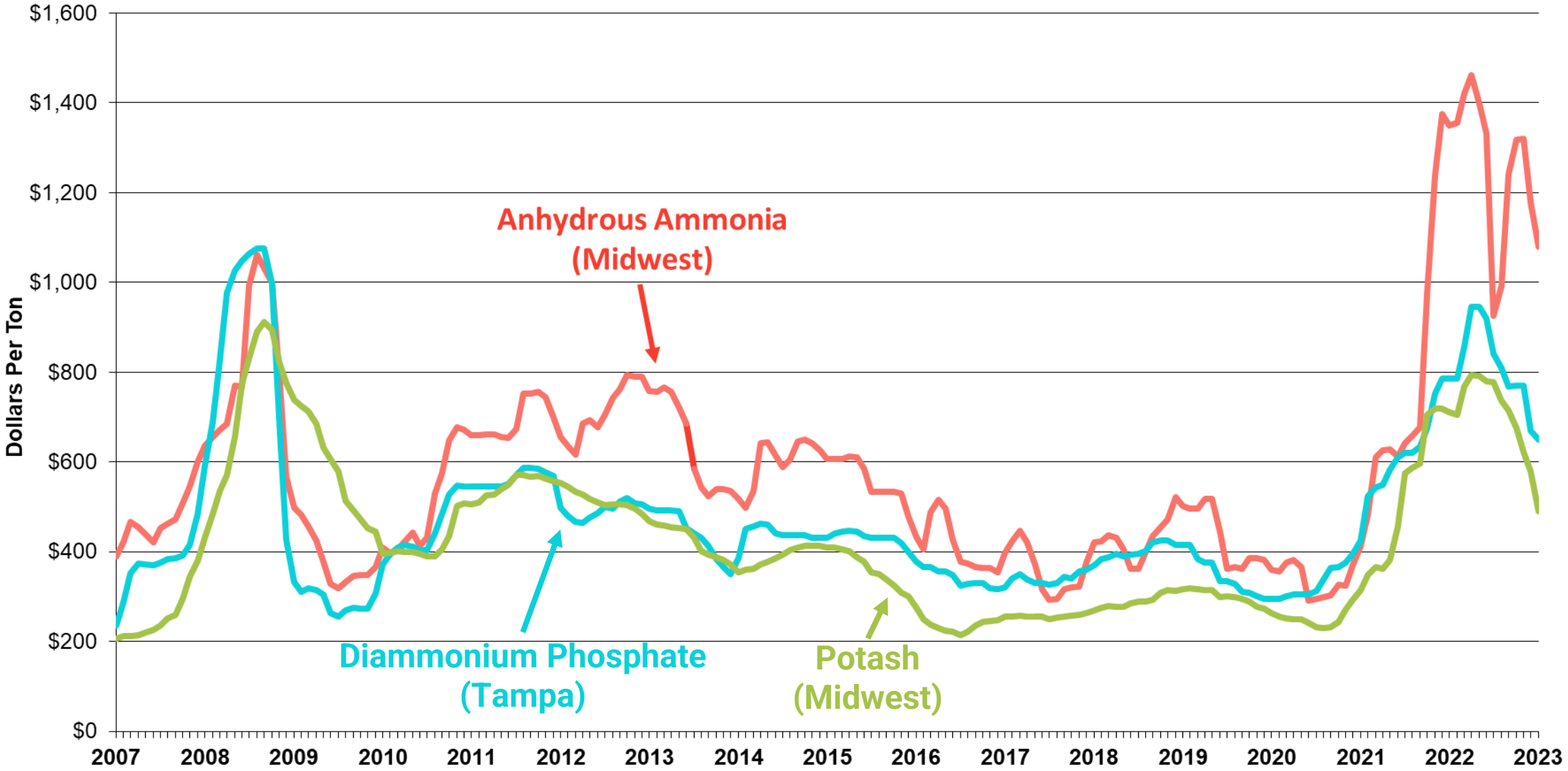
Monthly Fertilizer Prices: Jan 2007 – Jan 27, 2023



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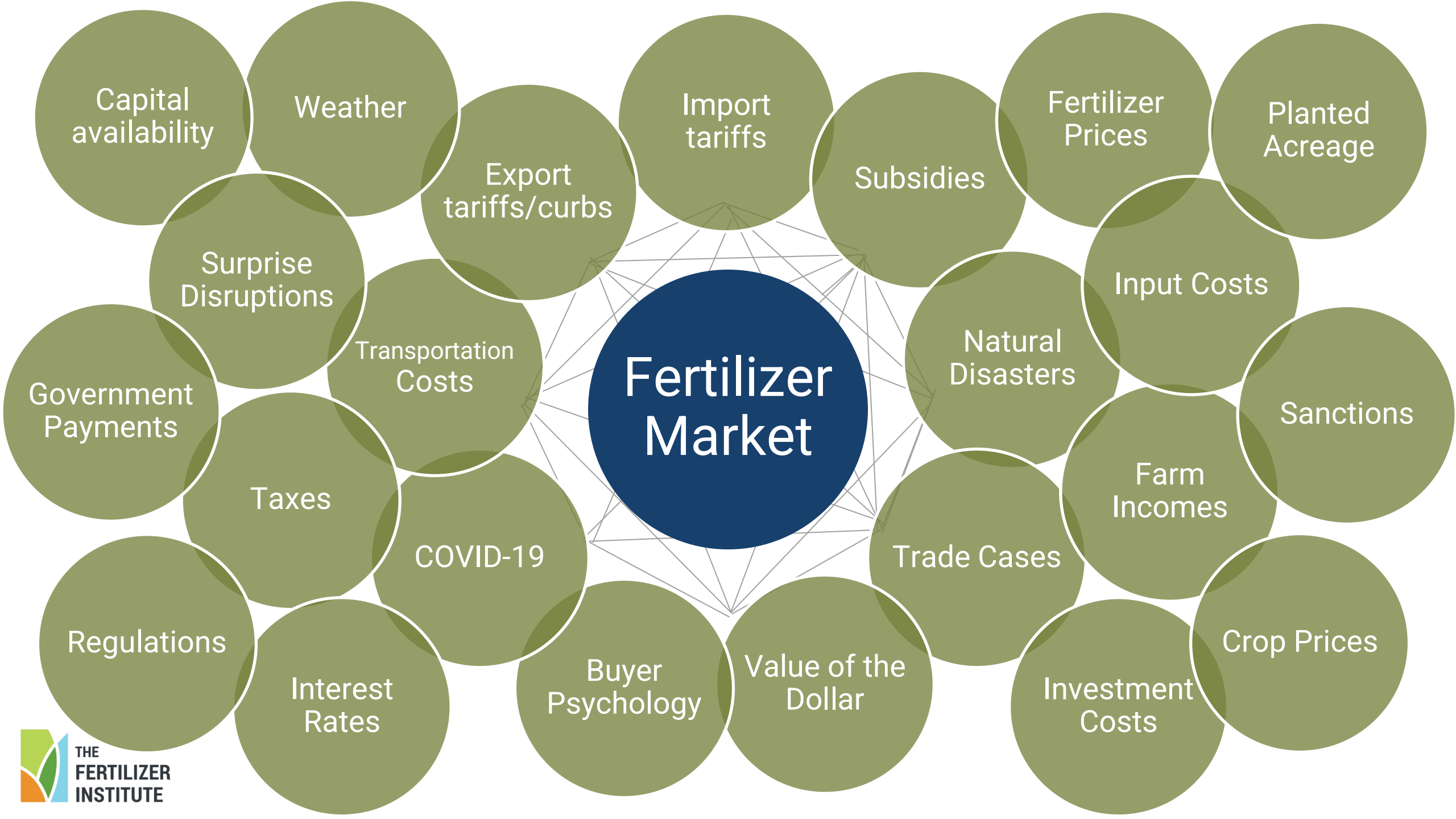
Source: Weekly prices reported in Green Markets (A Bloomberg Company).


Capital availability
Weather
Export tariffs/curbs
Import tariffs
Subsidies
Fertilizer Prices
Planted Acreage
Surprise Disruptions
Transportation Costs
Government Payments
Taxes
COVID-19
Regulations
Interest Rates
Buyer Psychology
Value of the Dollar
Trade Cases
Natural Disasters
Input Costs
Sanctions
Farm Incomes
Crop Prices
Investment Costs
Fertilizer Market
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Global Market

~90% of global nutrient use is outside of the United States

Source: International Fertilizer Association (IFA).

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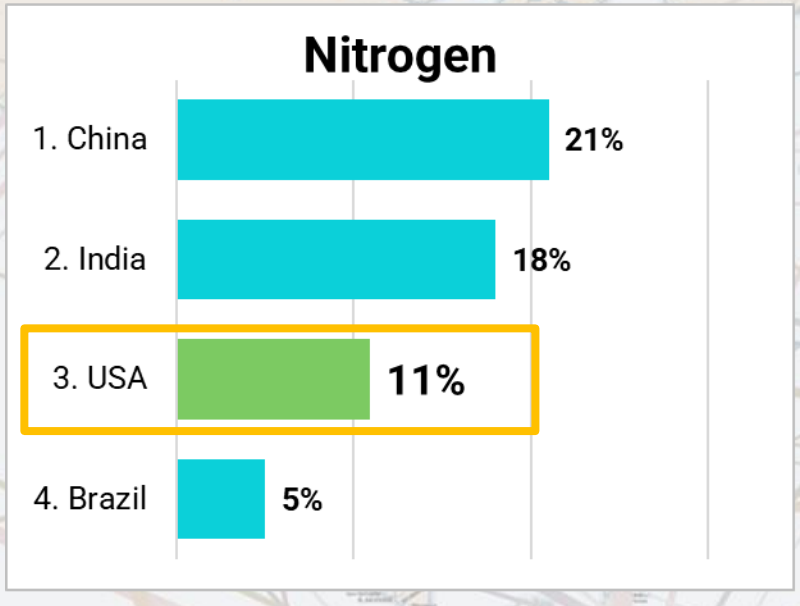
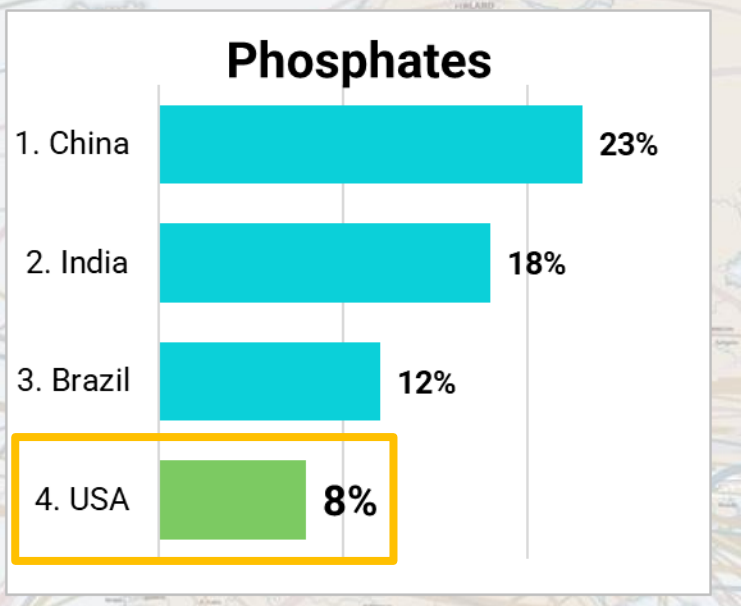
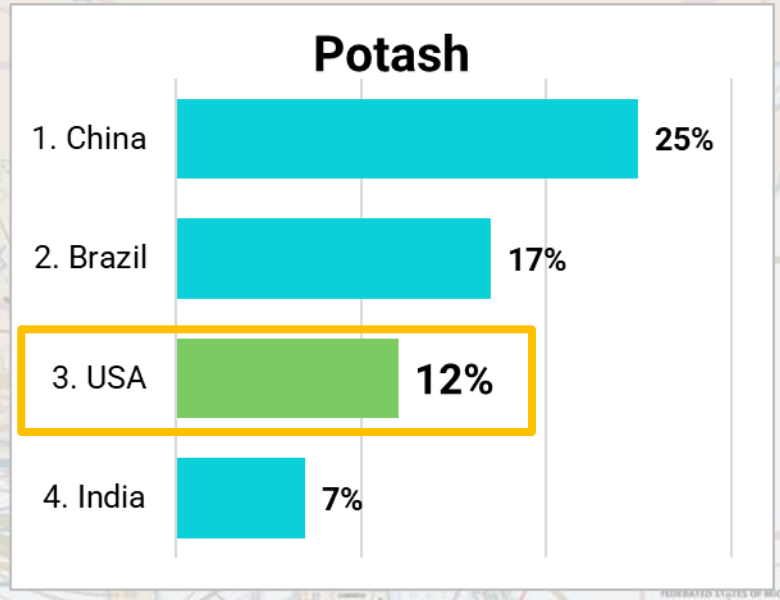
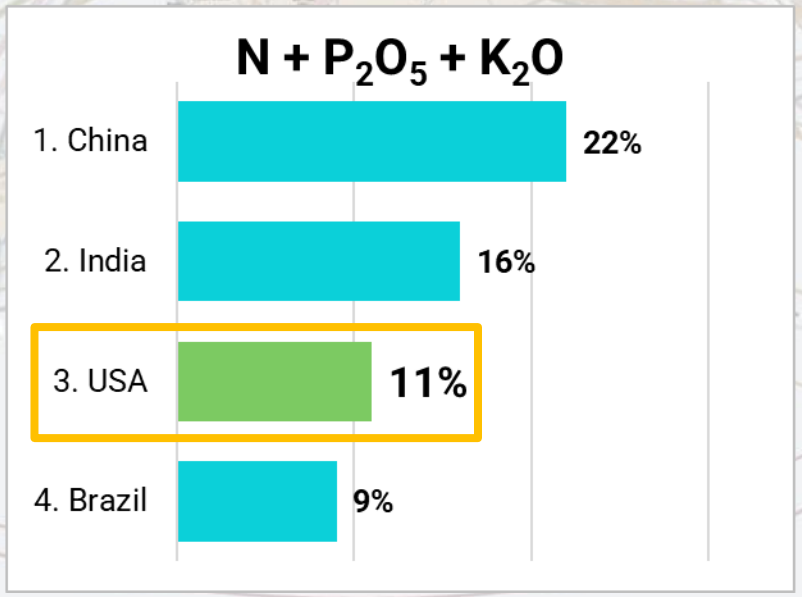
Global Consumers - 2020









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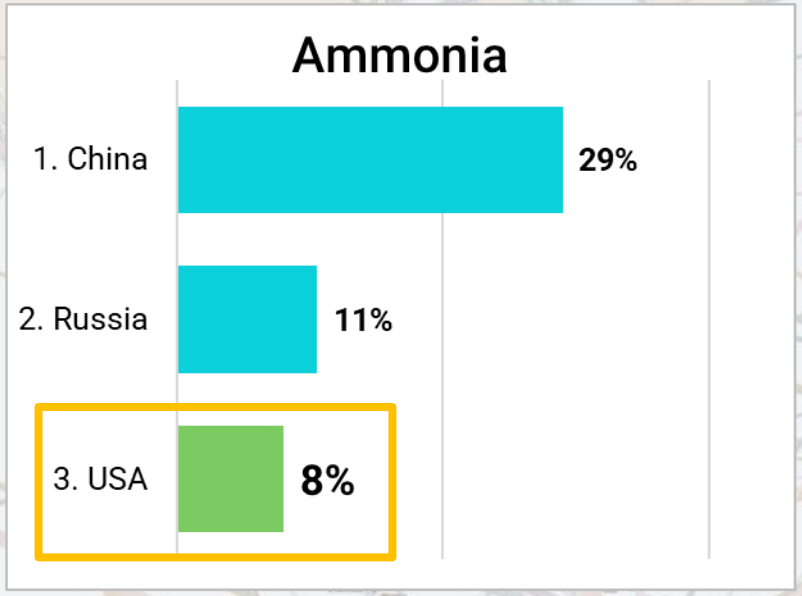
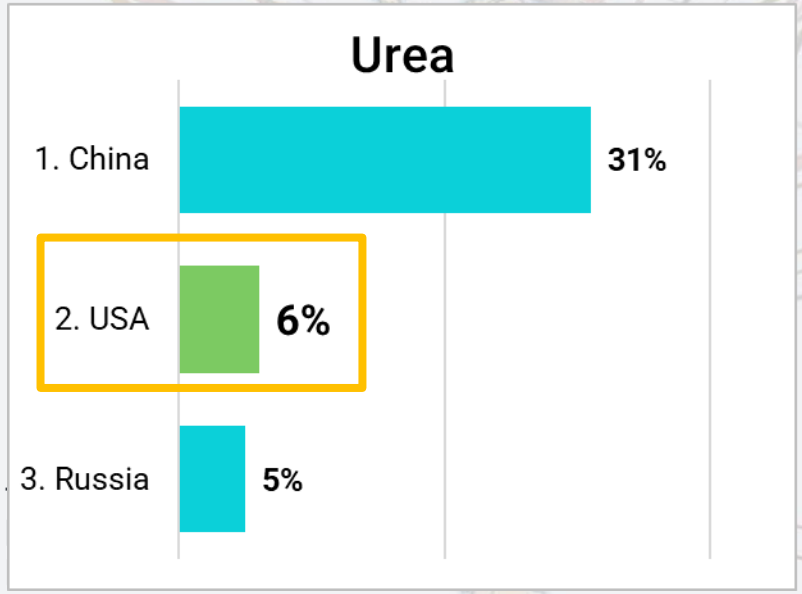
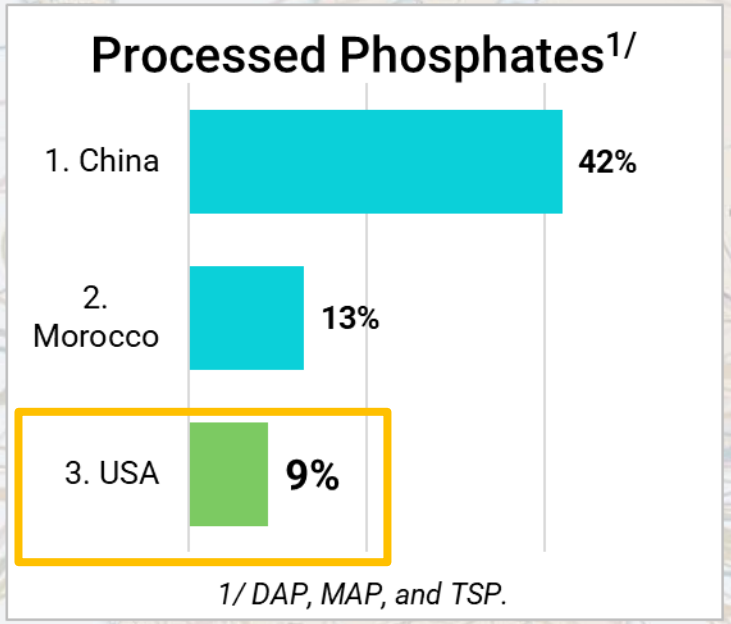
Source: International Fertilizer Association (IFA).

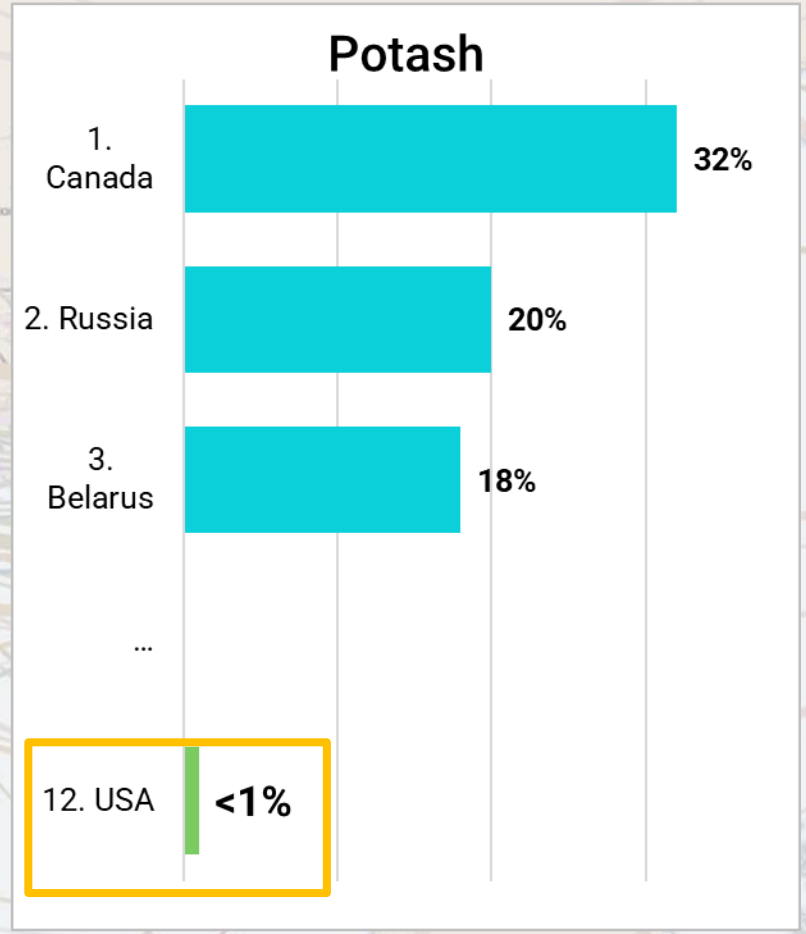
Global Producers - 2021





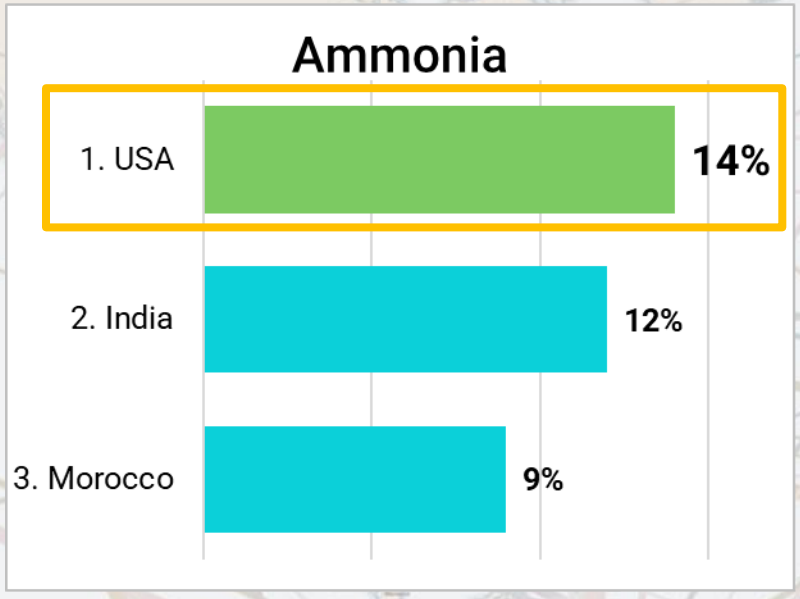


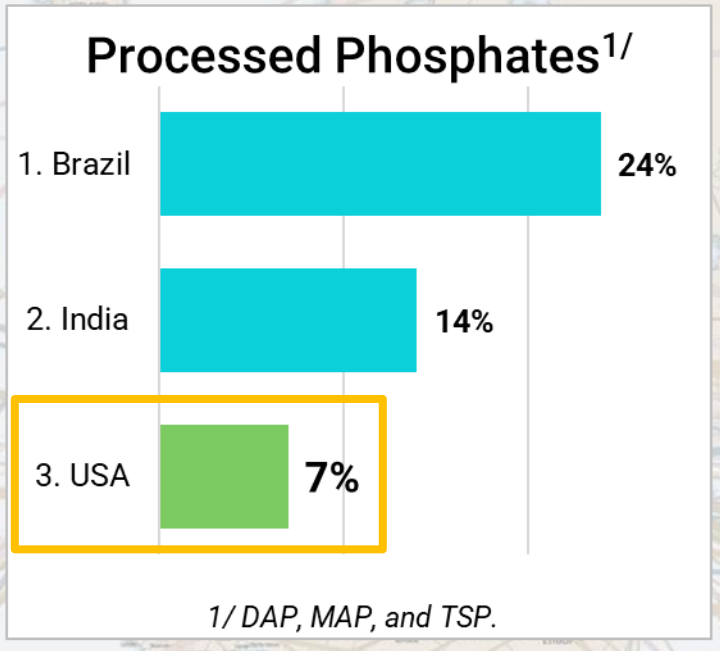
1/ DAP, MAP, and TSP.

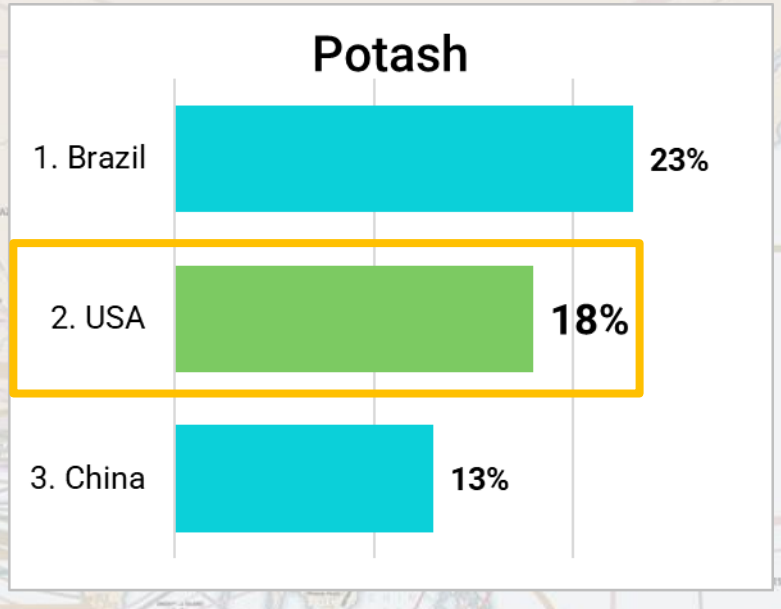


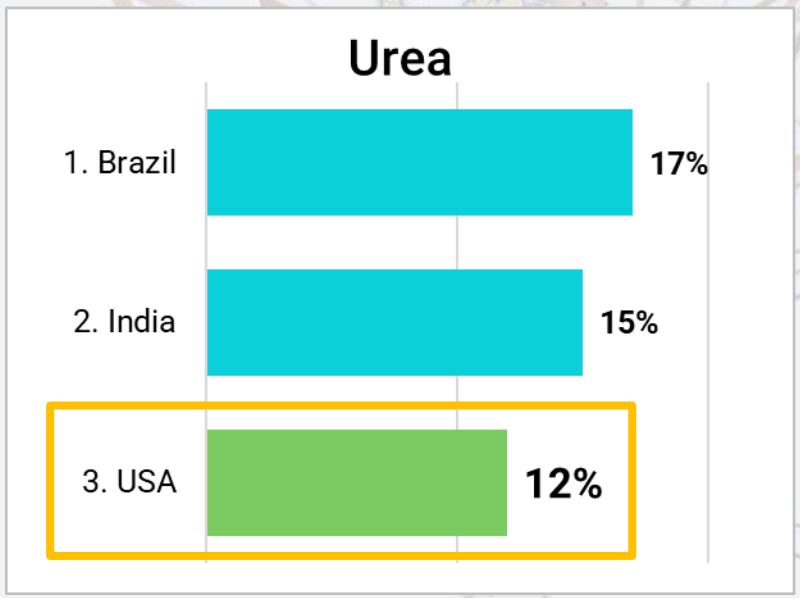
Source: International Fertilizer Association (IFA).

Global Importers - 2021

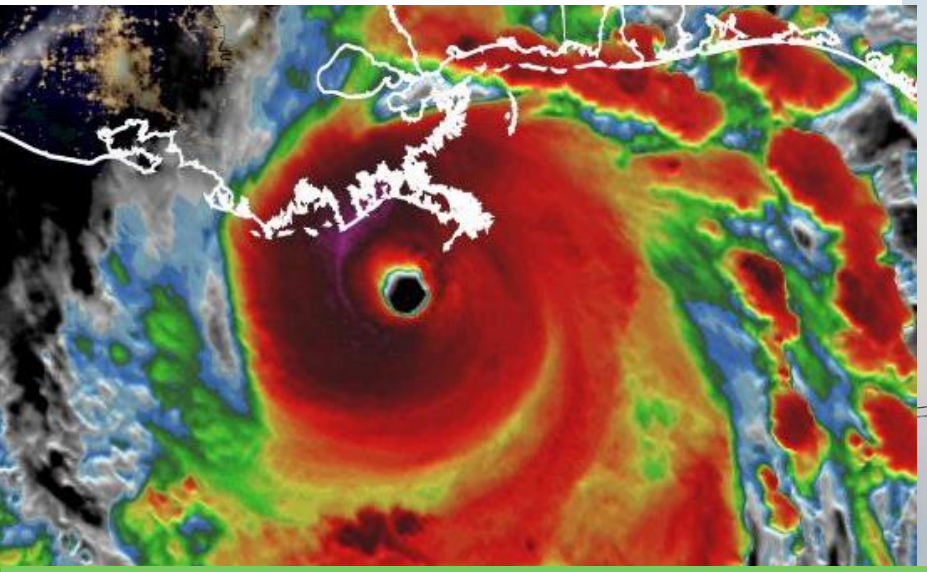








Source: International Fertilizer Association (IFA).



Weather Events

Input Costs

Trade Disruptions

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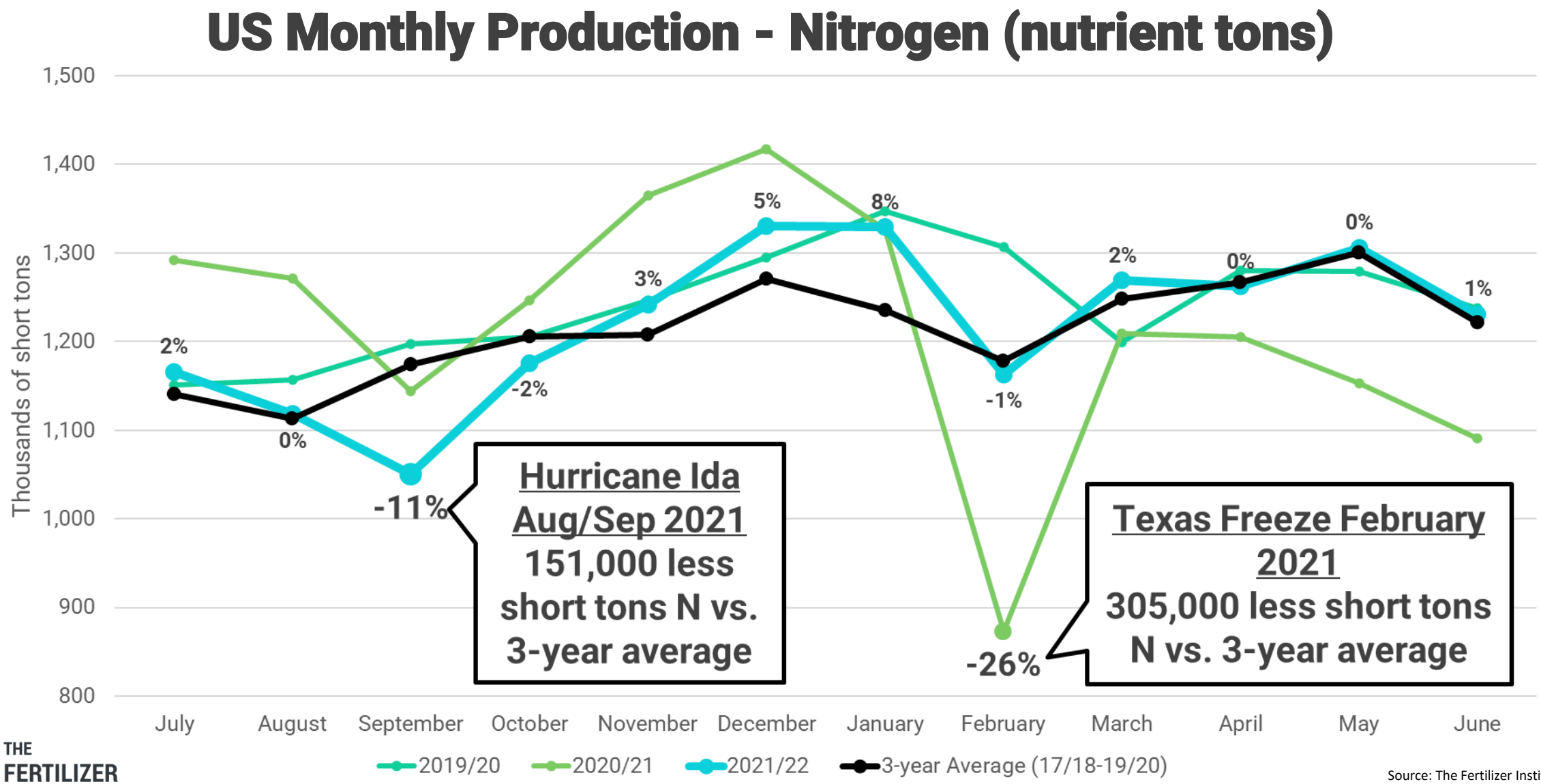
Weather Events



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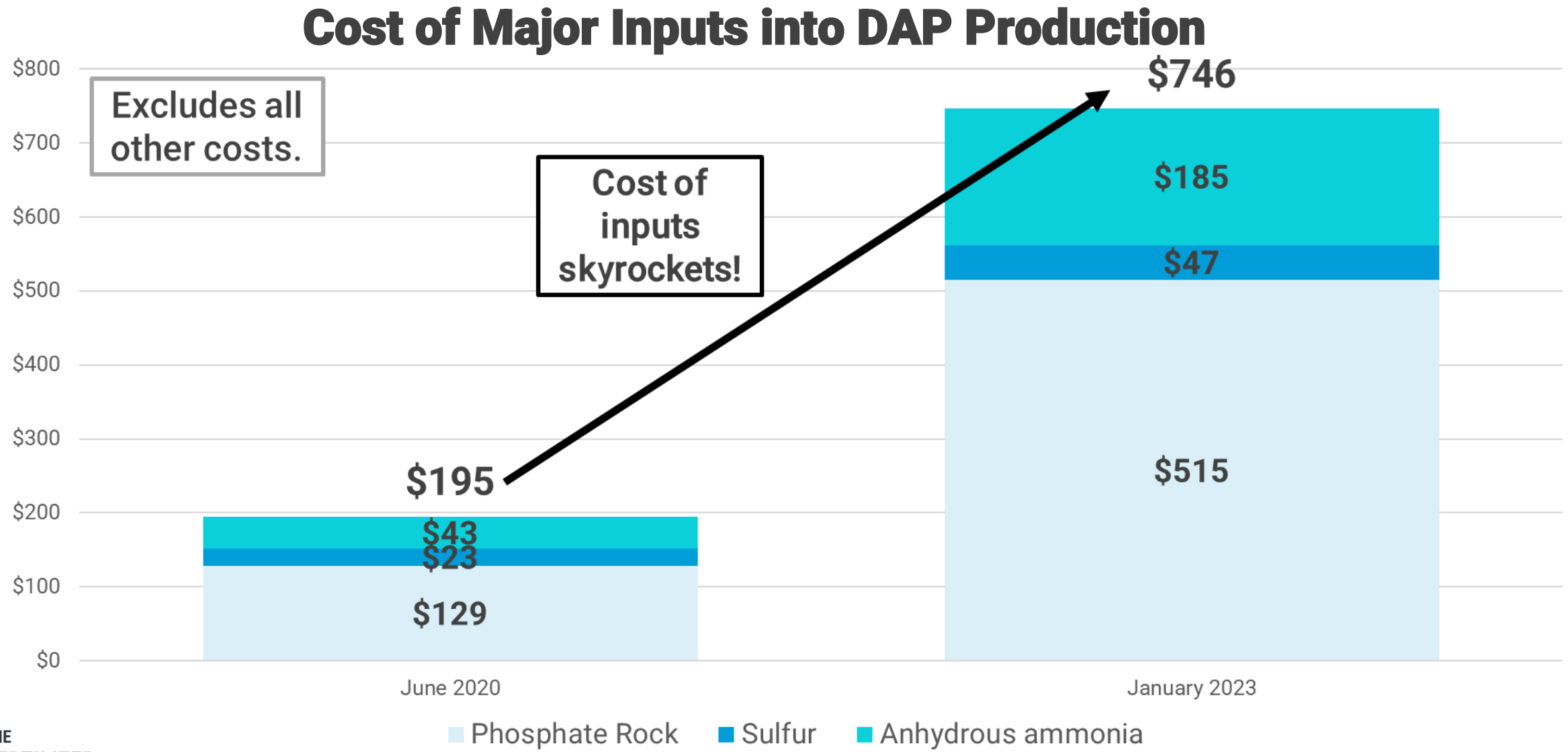
Source: The Fertilizer Institute (TFI).

Input Costs



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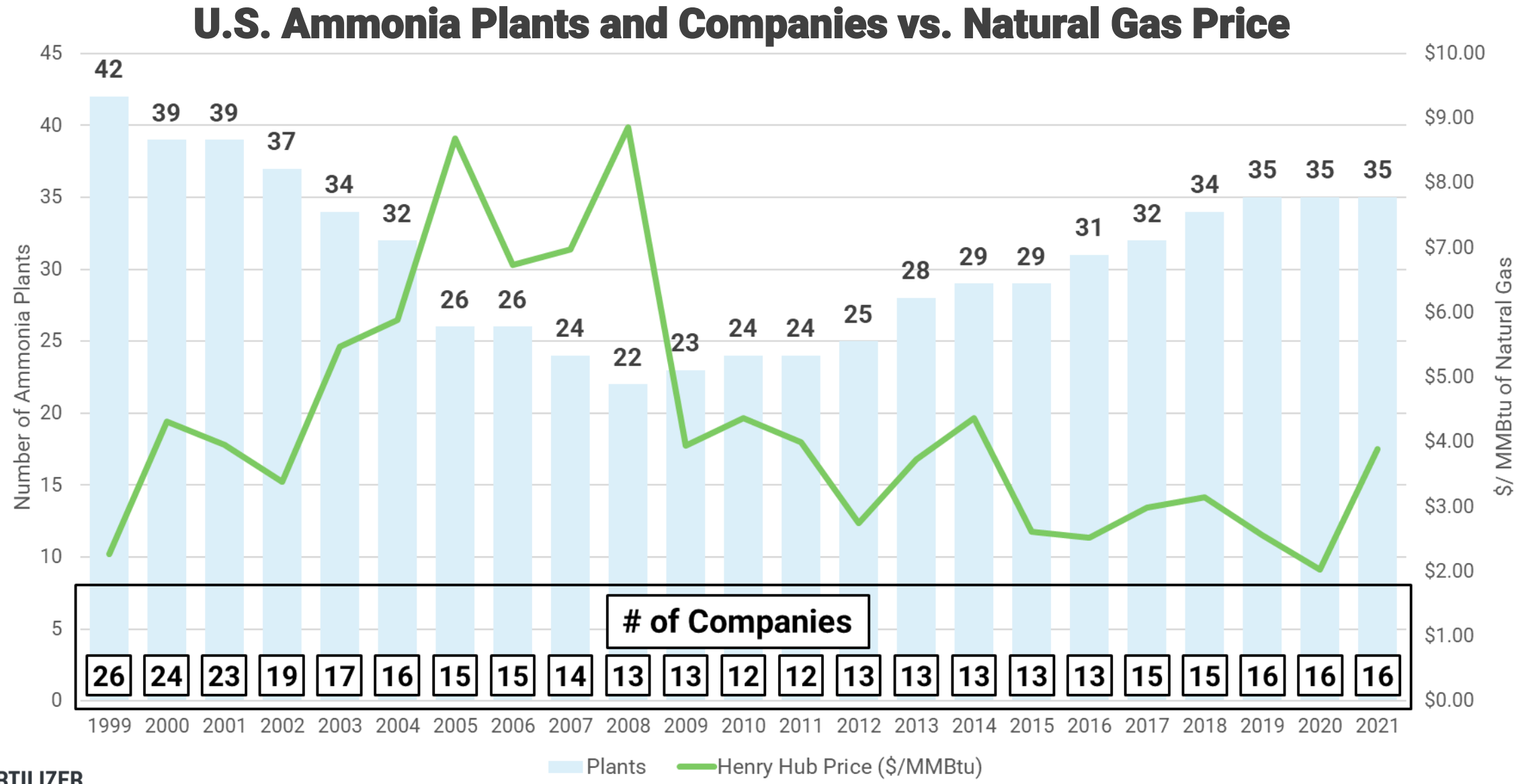
Source: Weekly prices reported in Green Markets (A Bloomberg Company).

Input Costs



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Source: USGS Data

Trade Disputes

Russian Sanctions

Russian 2022 Fertilizer Revenues Soar, Report Says

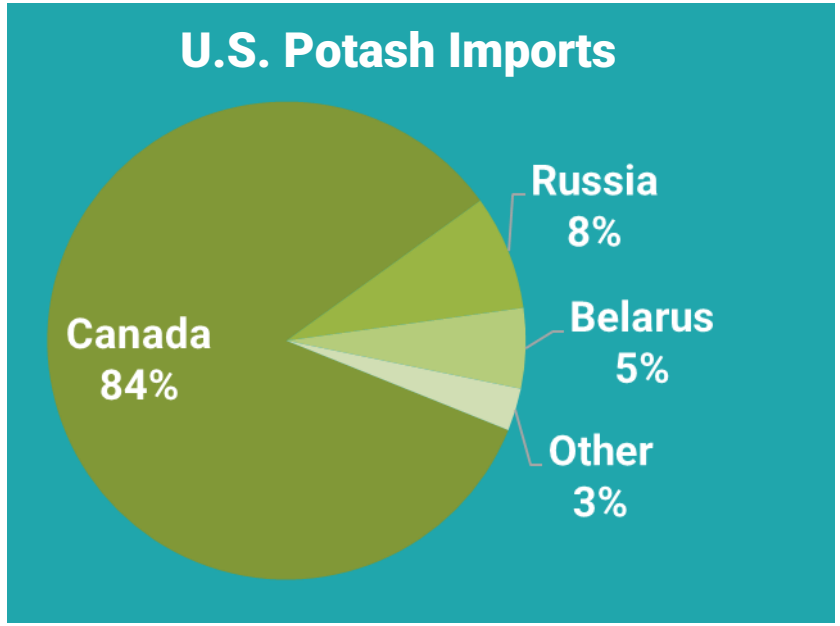
January 20, 2023 News, News Briefs, Russia

BUSINESS | MARKETS | News reporting

Russia situation likely to continue to upend fertilizer markets

Russia Increases Fertilizer Export Quotas by Some 0.5 M mt

January 27, 2023 Ammonium Nitrate, Featured, News, Russia

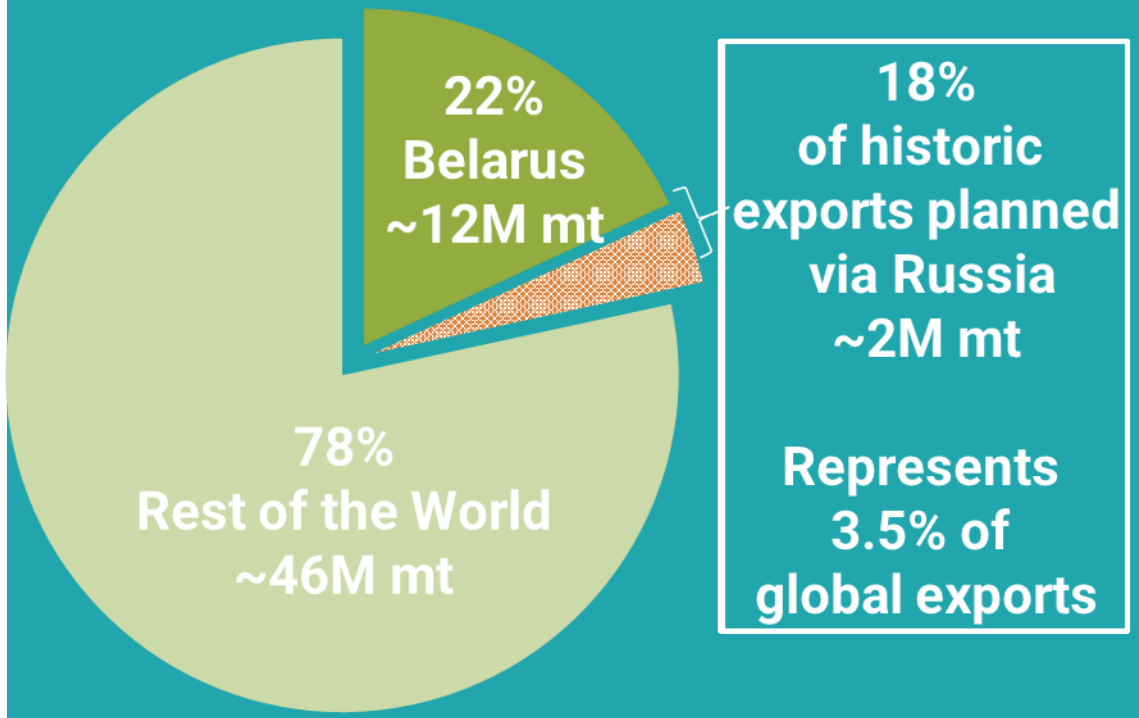


Source: International Fertilizer Association (IFA), 2021.

Trade Disputes

Belarus Sanctions

Global Potash Exports



Belarus Exports 1 M Mt of Potash to China by Rail in 2022, Targets Pre-Sanctions Export Levels in 2023

January 6, 2023 Belarus, China, News, News Briefs, Potash

China Curbs Exports

Global Phosphate Exports

China extends phosphate export restrictions

By Sean Pratt | Published: August 11, 2022

Source: International Fertilizer Association (IFA), 2021.

Fertilizer Demand

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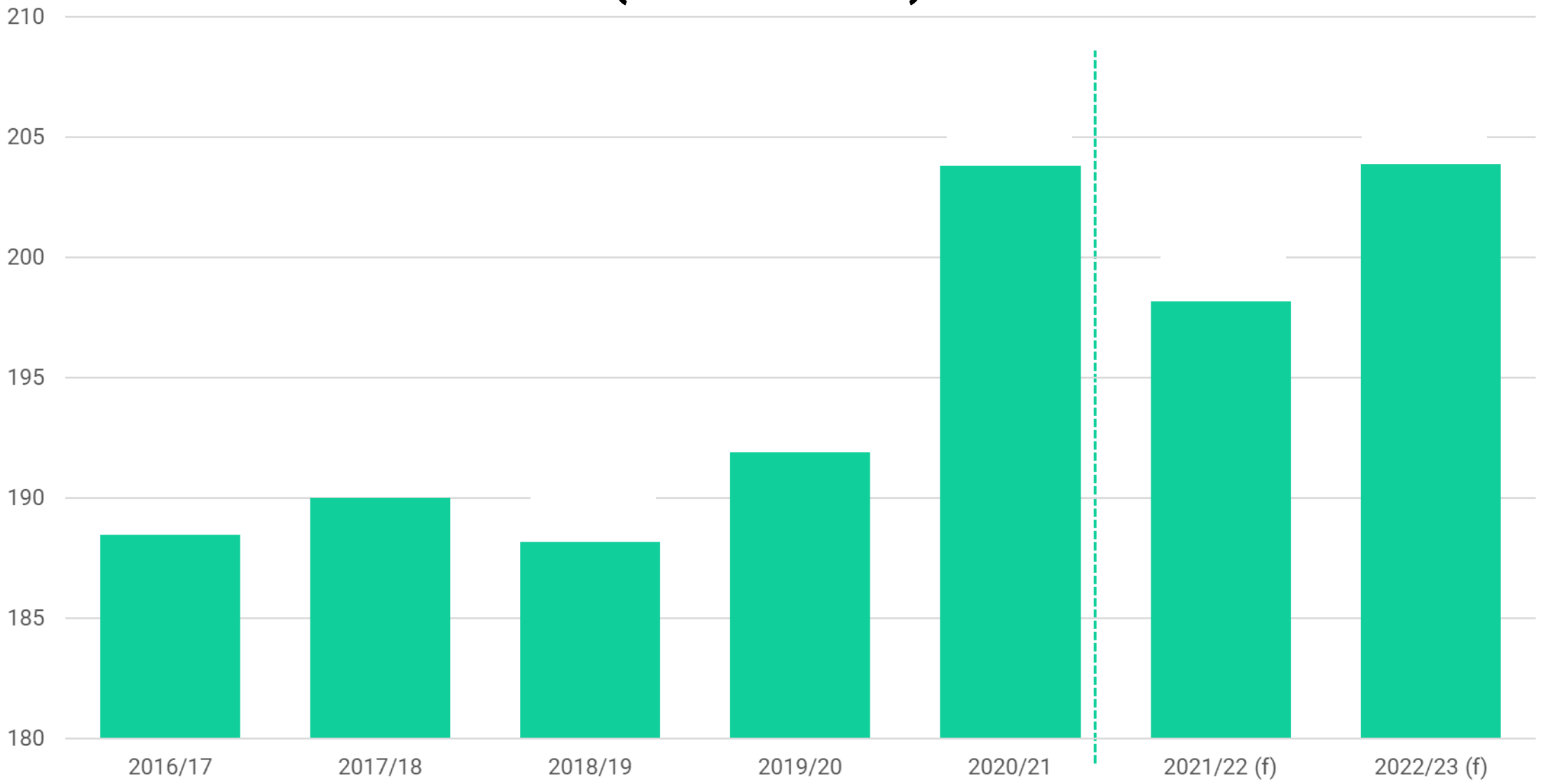
Global Demand
(Mt nutrients)



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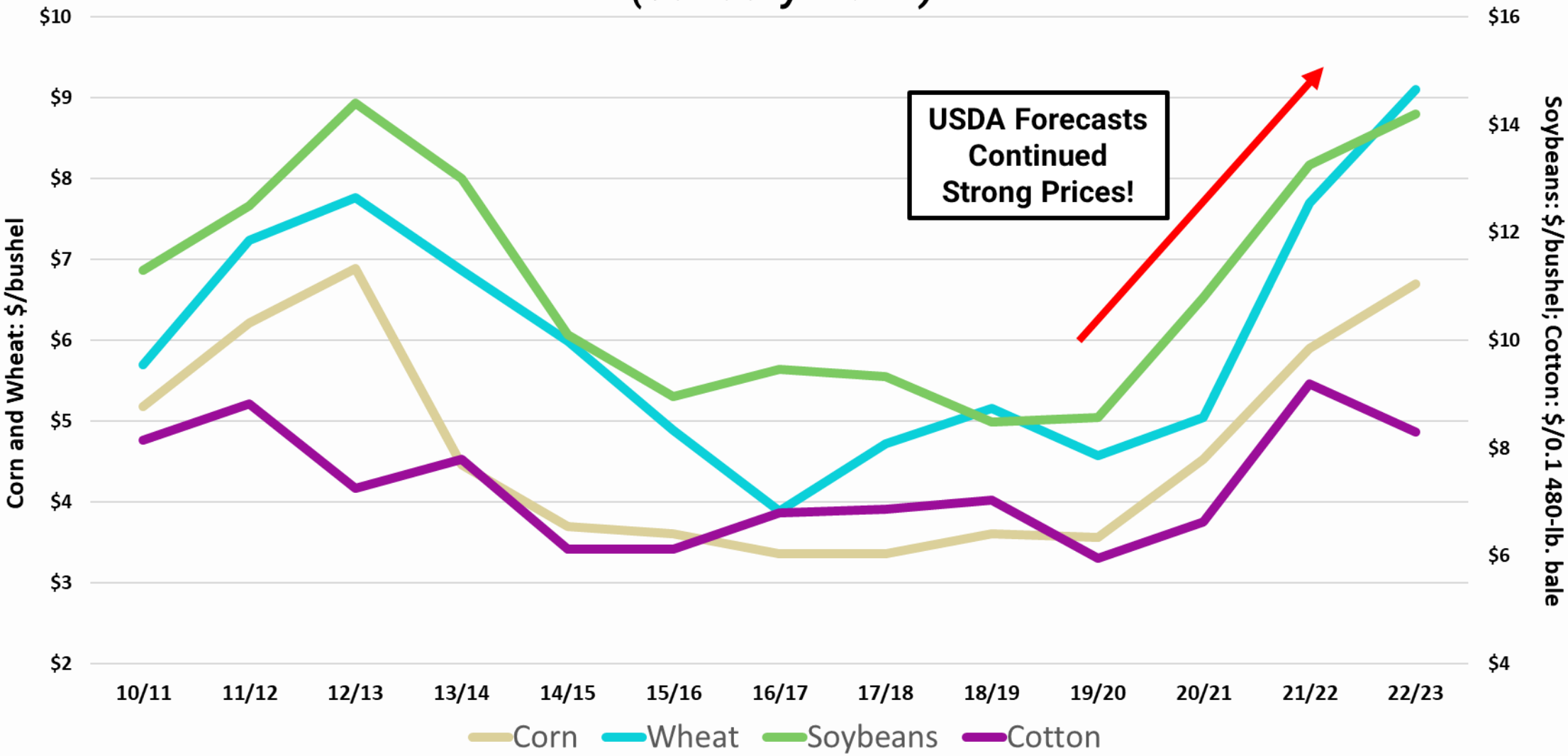
Source: International Fertilizer Association (IFA).

Season Average Crop Prices

(January 2022)



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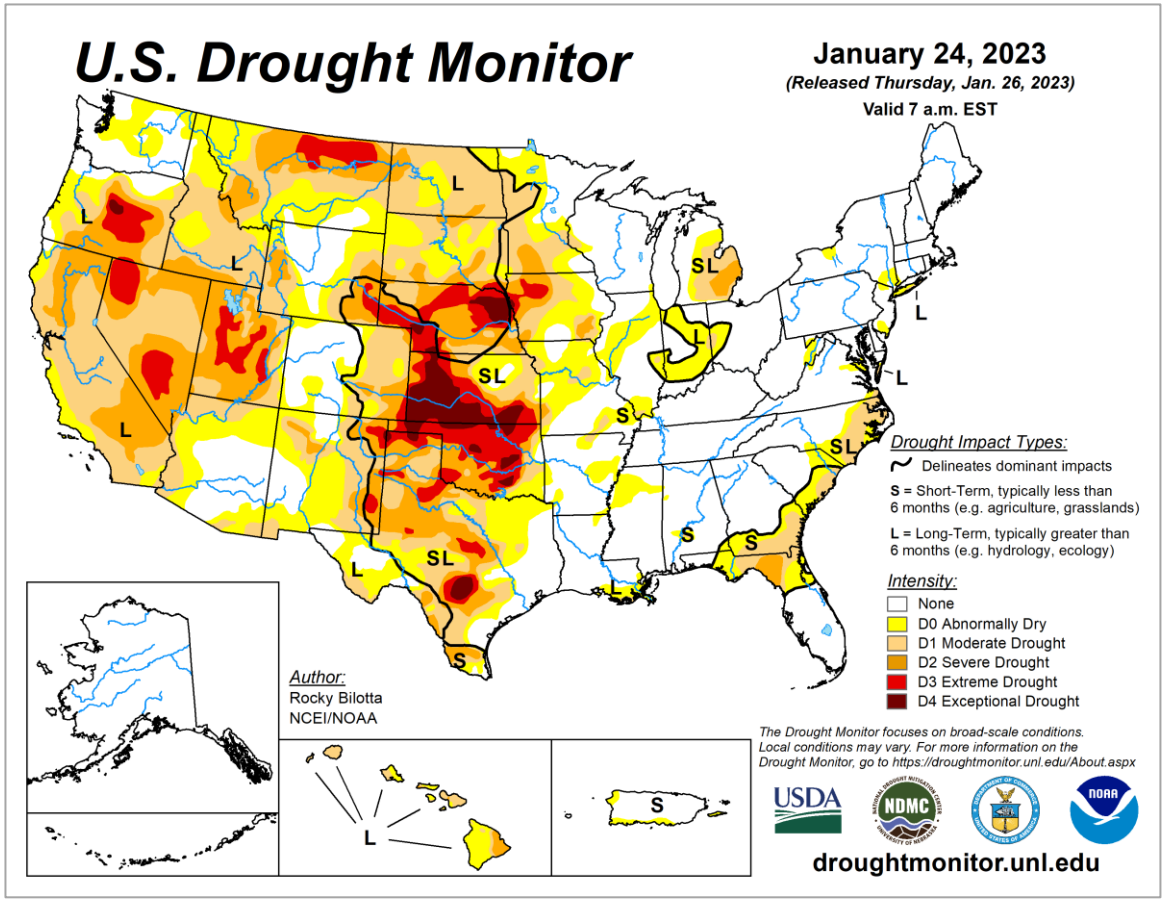
Source: WASDE, USDA.

Fertilizer Application Adjustments

– *Will crop prices remain strong to support fertilizer demand (relative prices)?*

– *Will poor weather cause a decrease in fertilizer application?*



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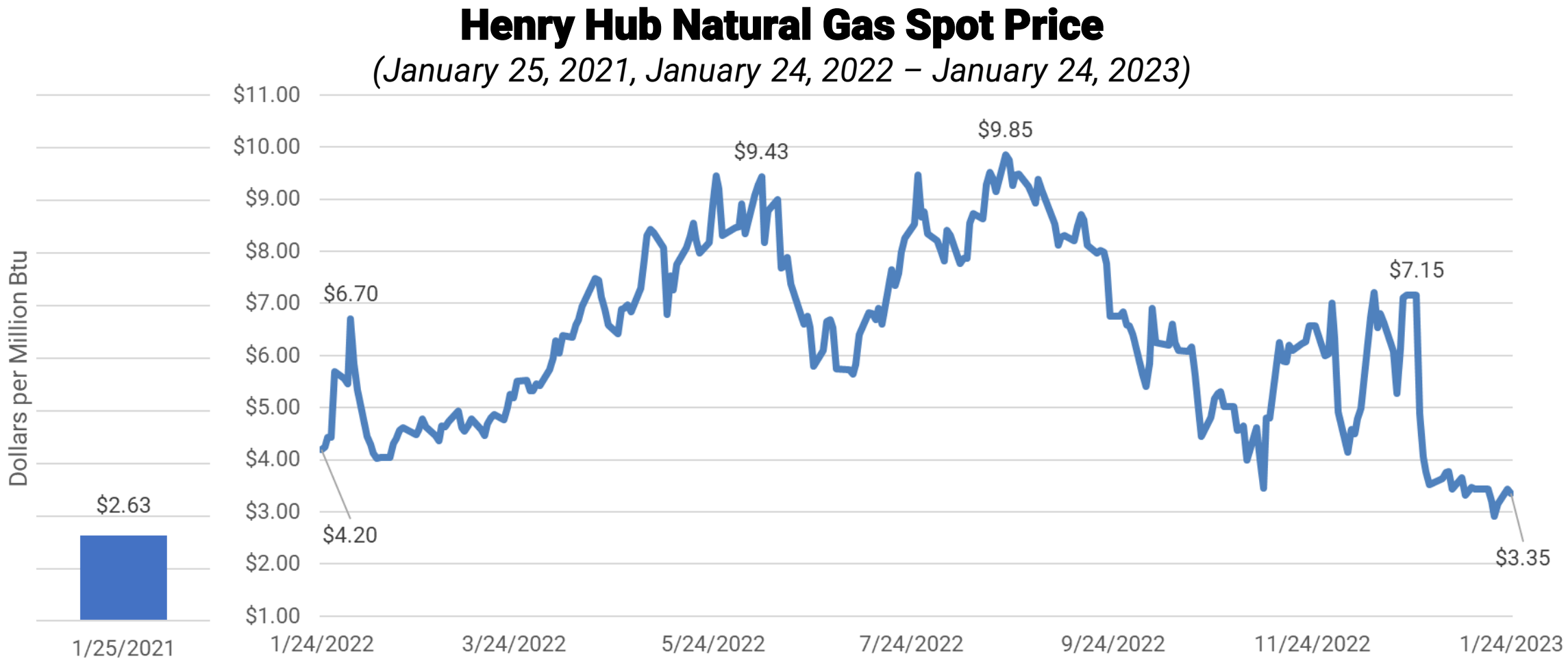
Fertilizer Price: Natural Gas

–Will natural gas prices continue to rise or remain high in the US?



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Source: Energy Information Administration (EIA).

Example of European Gas Crisis

–With high natural gas prices, what will happen to producers in Europe?

Dutch TTB Natural Gas Futures Prices

(January 27, 2021, January 27, 2022 – January 27, 2023)

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Source: Investing.com

Other Unforeseen Supply Disruptions

- **Supply Disruptions**
  - *–Will there be any events that will disrupt production/supply?*

More than 40 million people are under winter weather alerts from Texas to West Virginia, with significant icing likely

By Rob Shackelford and Derek Van Dam, CNN
Updated 8:44 AM EST, Mon January 30, 2023

UPDATE 2-FERTILIZER PRODUCER MOSAIC SAYS STOCKPILES TOO HIGH TO RESTART CANADIAN MINE

1/25/2023

Low Mississippi River Barge Disruptions: Effects on Grain Barge Movement, Basis, and Fertilizer Prices

Shawn Arita, Vince Breneman, Seth Meyer, and Brad Rippey
Office of the Chief Economist
USDA[1]

November 2, 2022

No injuries in accidental fertilizer plant fire in southwest Nebraska

A structure fire at a fertilizer plan in southwest Nebraska has been ruled an accident by the Nebraska State Fire Marshal's office.

Sunday, January 15th 2023, 9:36 AM CST

MARKETS AGL (Agritech Limited) 4.33 ▲ 0.7%

Fertiliser maker suspends urea production amid RLNG suspension

- Number of companies have either shut or limited their operations, citing import restrictions, energy shortages and low demand

BR Web Desk Published January 4, 2023

Freight railroad service is terrible, even without the threat of a strike

By Chris Isidore, CNN
Published 12:07 PM EST, Sun December 11, 2022

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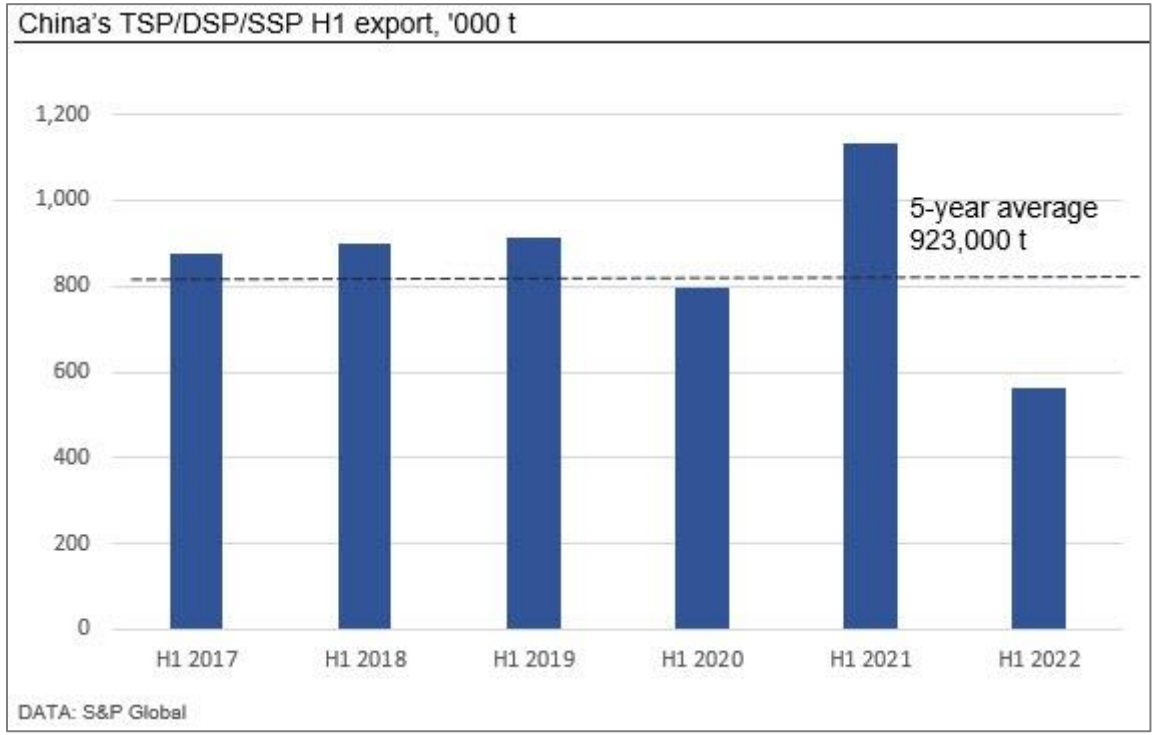
Supply & Geopolitics: China & Russia

– *When will China return to the global market and how much will volumes rebound?*



– *What second order impacts are still yet to come from the Russian invasion?*

Russia and Ukraine renew a grain export deal to help the hungry and keep prices down

Updated November 17, 2022 · 10:02 AM ET

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Government Support

–How will government support change the dynamics of the markets?

Biden-Harris Administration Makes $500 Million Available to Increase Innovative American-Made Fertilizer Production

New Grant Program Will Spur Competition and Help U.S. Farmers Address Rising Costs

WASHINGTON, Sept. 27, 2022 – U.S. Department of Agriculture (USDA) Secretary Tom Vilsack today announced that the Biden-Harris Administration is making $500 million in grants available to increase American-made fertilizer production to spur competition and combat price hikes on U.S. farmers caused by the war in Ukraine.

Press Release
Release No. 0207.22

Contact: USDA Press
Email: press@usda.gov

USDA Announces New Opportunities to Improve Nutrient Management

Historic funding from Inflation Reduction Act an unprecedented investment in American agriculture

WASHINGTON, Aug. 15, 2022 – The U.S. Department of Agriculture (USDA) welcomed the passage of the Inflation Reduction Act, which will deliver $19.5 billion in new conservation funding to support climate-smart agriculture. This historic funding will bolster the new steps that USDA's Natural Resources Conservation Service (NRCS) announced today to improve opportunities for nutrient management. NRCS will target funding, increasing program flexibilities, launch a new outreach campaign to promote nutrient management's economic benefits, in addition to expanding partnerships to develop nutrient management plans. This is part of USDA's broader effort to address future fertilizer availability and cost challenges for U.S. producers.

Press Release
Release No. 0178.22

Contact: USDA Press
Email: press@usda.gov

INVESTMENT

The Inflation Reduction Act is already advancing carbon capture

Direct-air capture and blue ammonia projects are planned for Wyoming, Texas

by ***Craig Bettenhausen***

September 13, 2022 | A version of this story appeared in **Volume 100, Issue 33**

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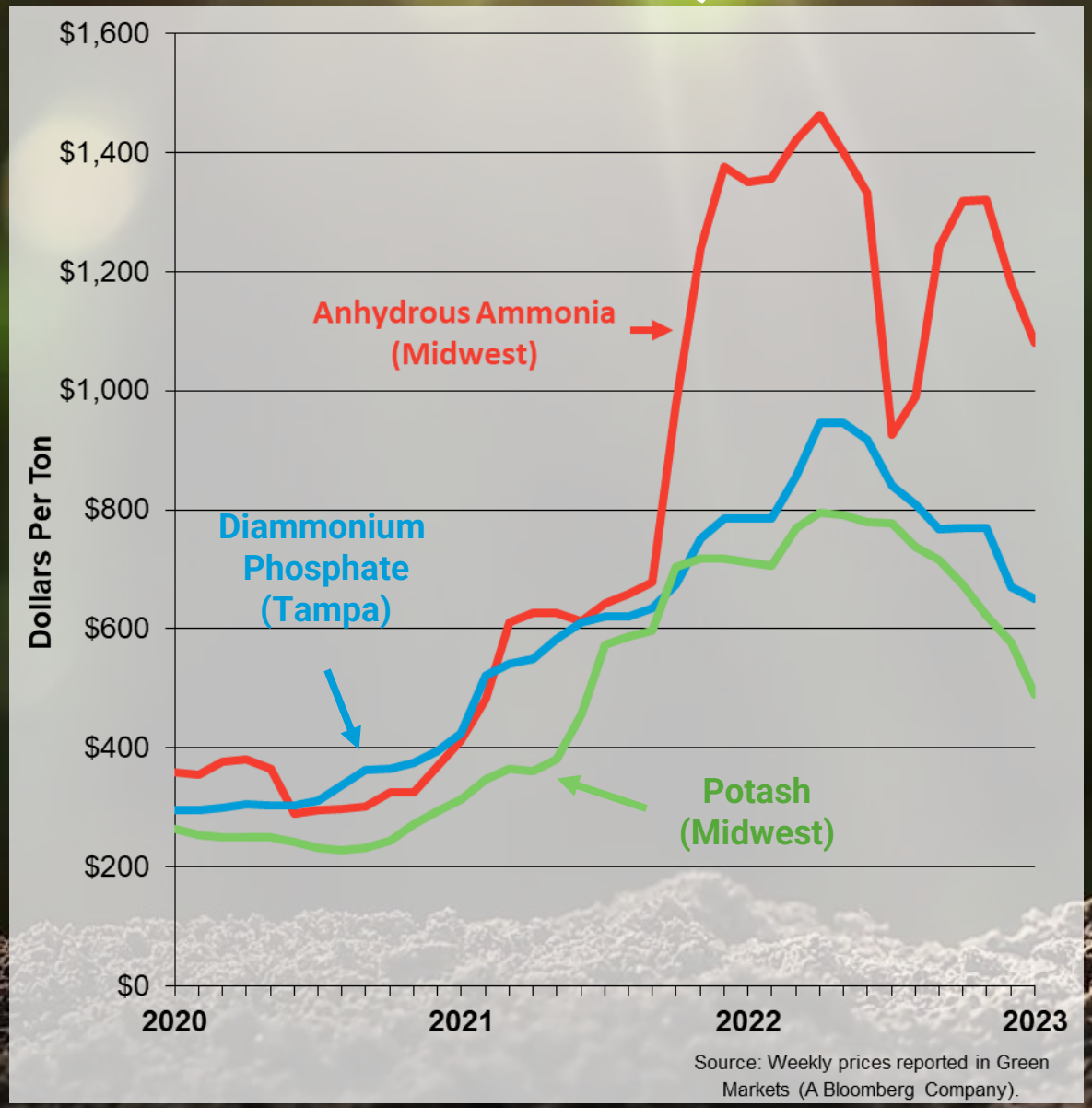
Moving Forward

Monthly Fertilizer Prices:
Jan 2020 – Jan 27, 2022



Navigating Volatility

NITROGEN (N)

- Natural gas prices – Europe & US
- Clearance of Russian exports
- Chinese export restrictions

PHOSPHATE (P)

- Raw material prices
- Clearance of Russian exports
- Chinese export restriction

POTASH (K)

- Rail shipments from Belarus
- Clearance of Russian exports
- New capacity

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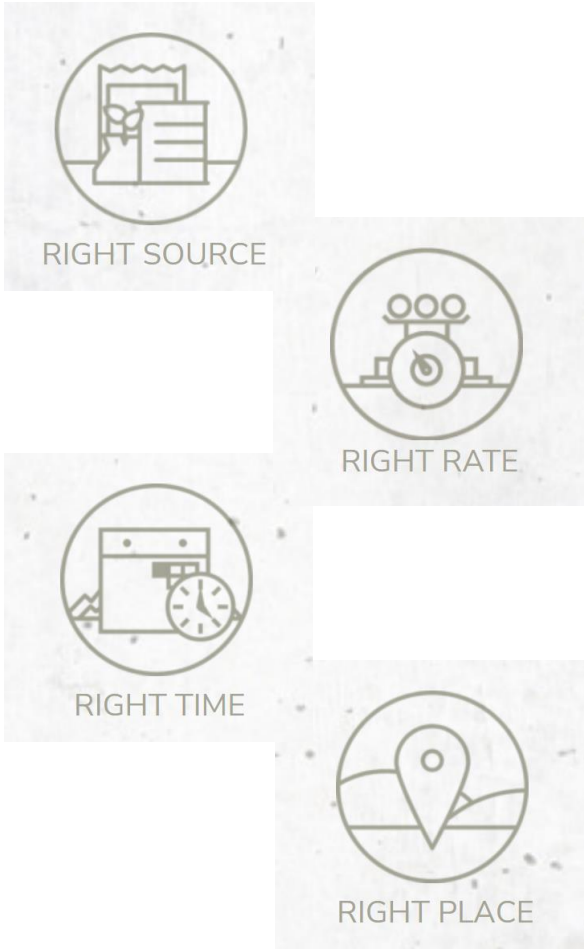
Navigating Volatility

Understand Needs

Implement 4R Practices

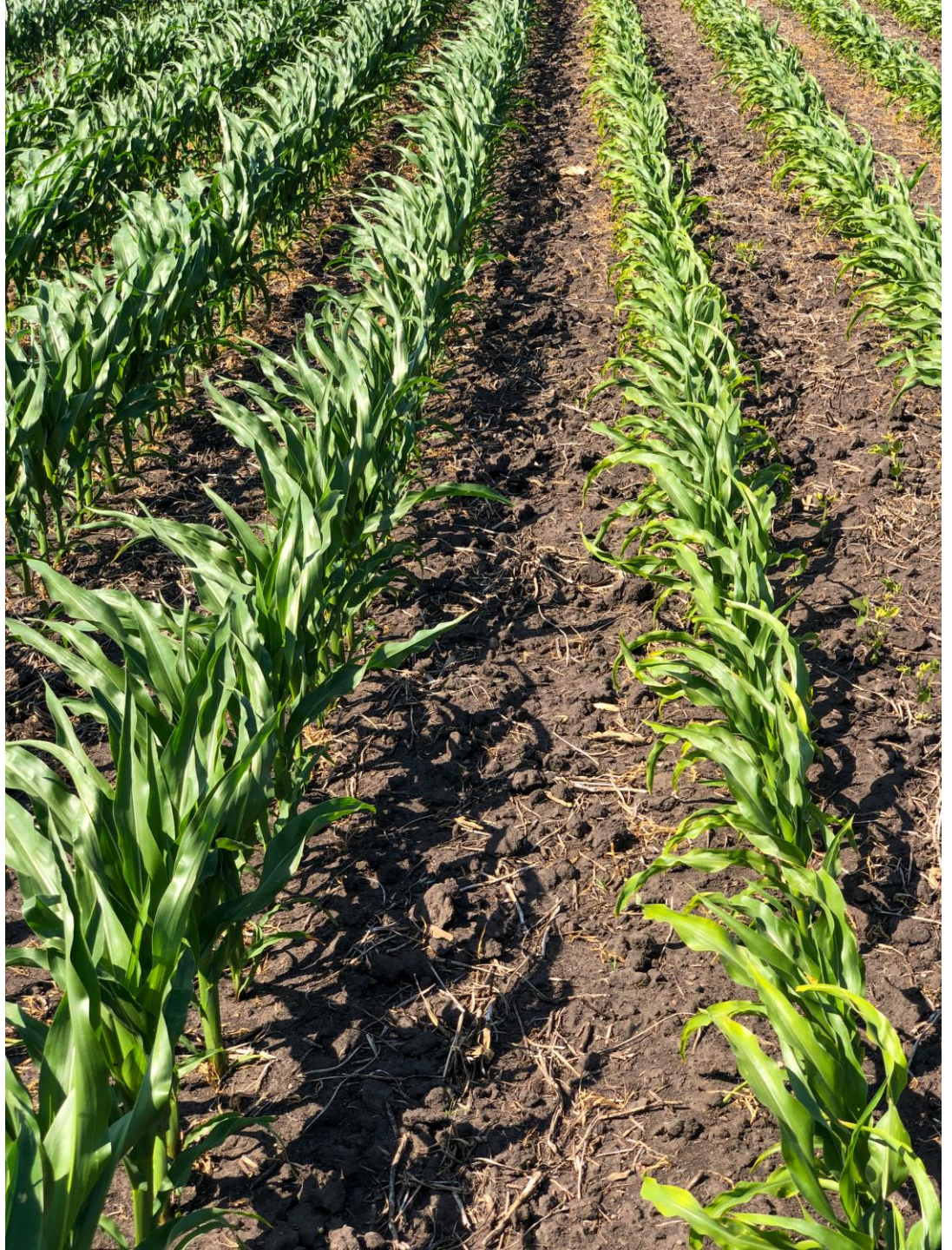


Communicate and Plan

Manage Risk

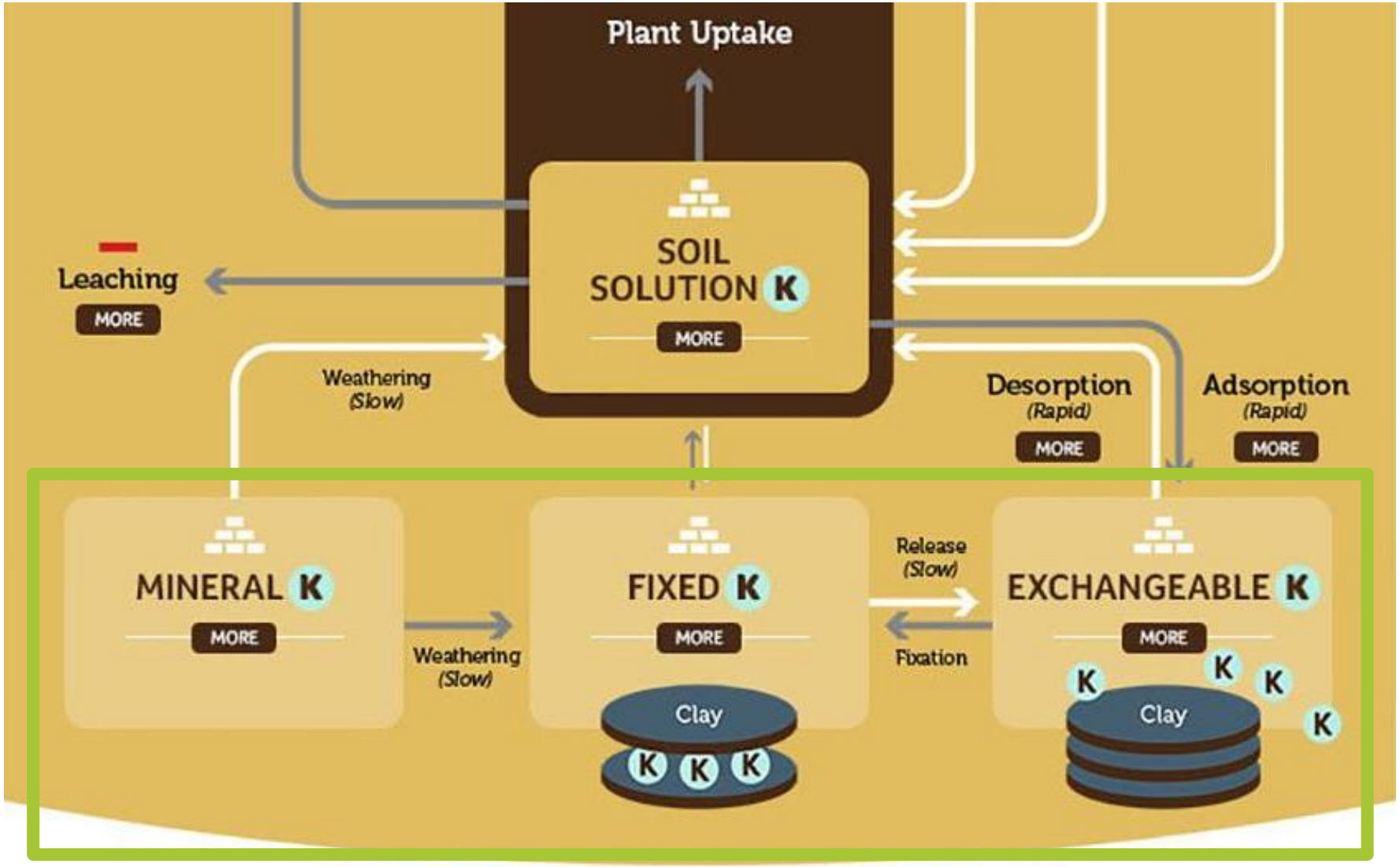
Part II: Potassium Research Update

Leanna Leverich & Daniel Kaiser



University of Minnesota

Potassium Pools in Soils



Factors influencing K Availability

Factors influencing K Availability

Clay Mineralogy

Soil Holding Capacity for K

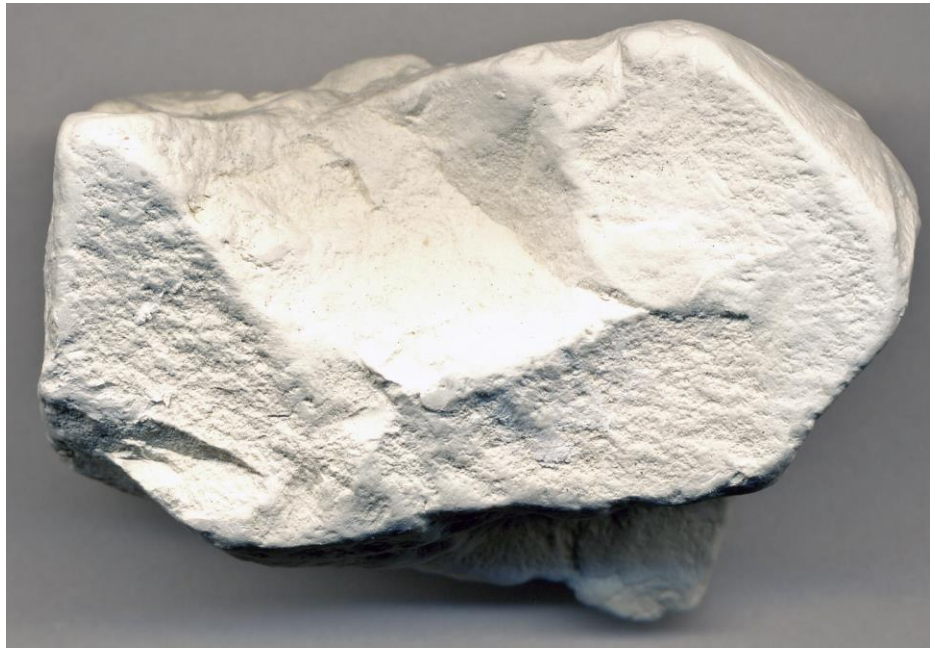
CEC

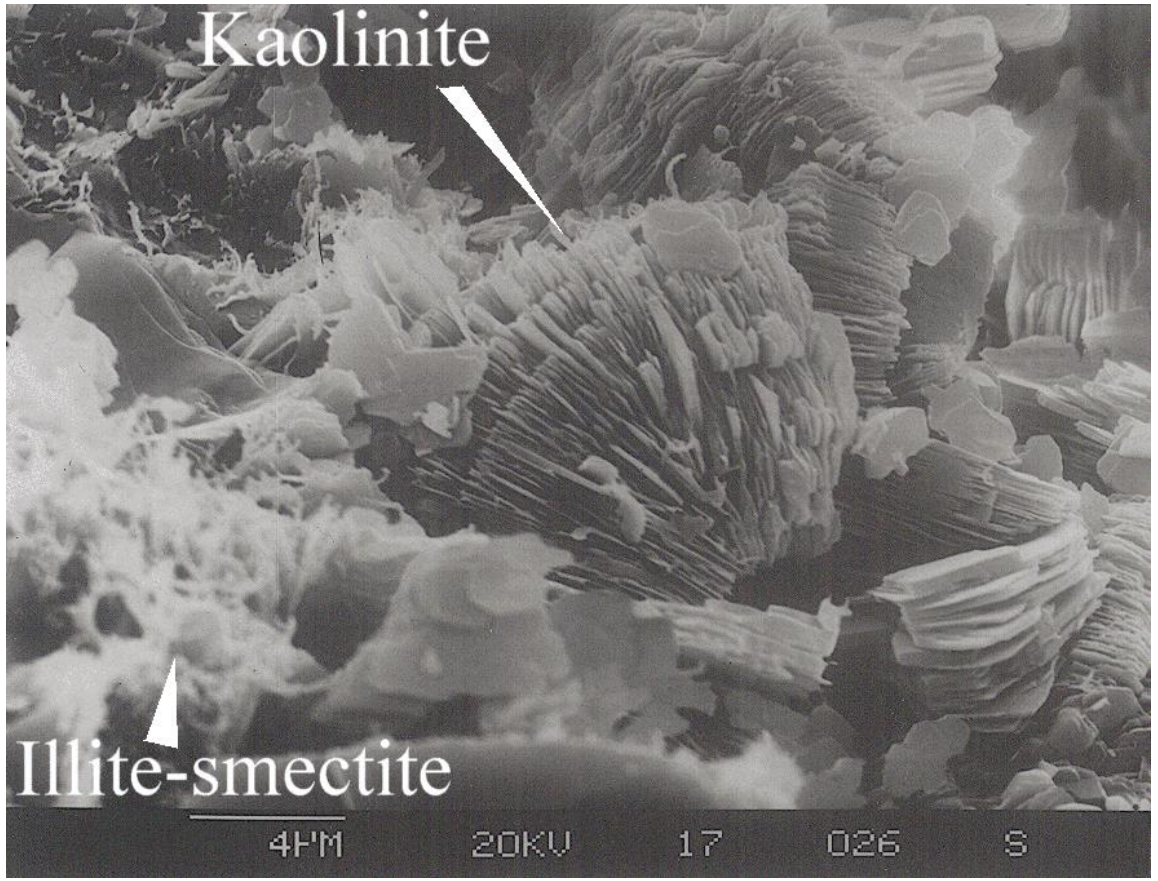
Texture

Other Cations

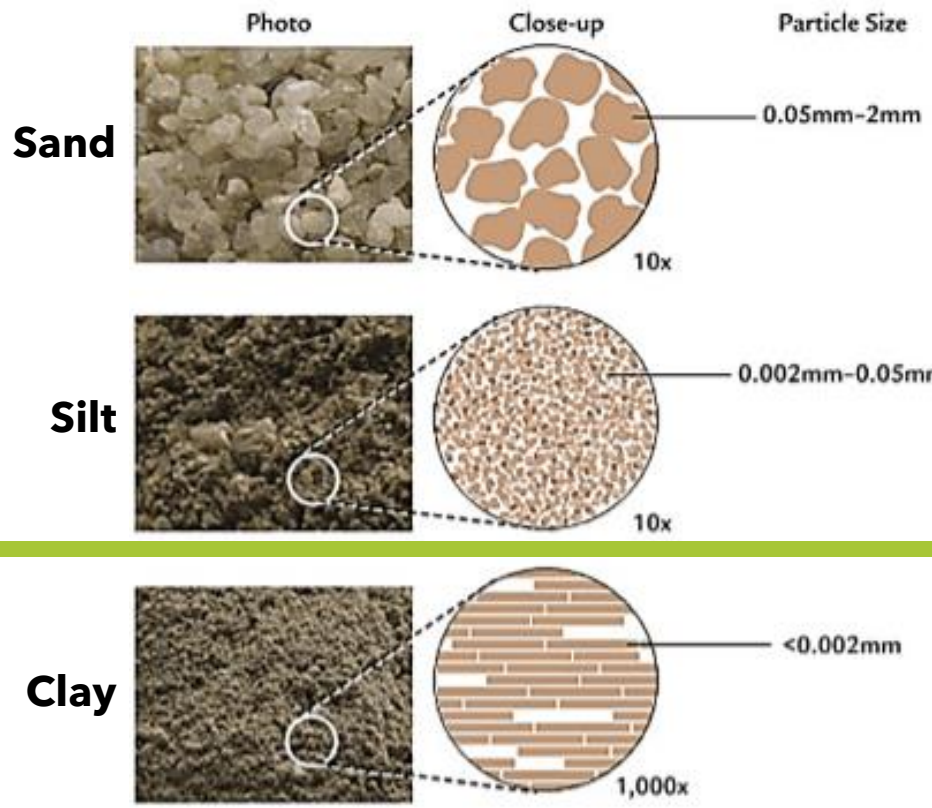
Cations competing with K

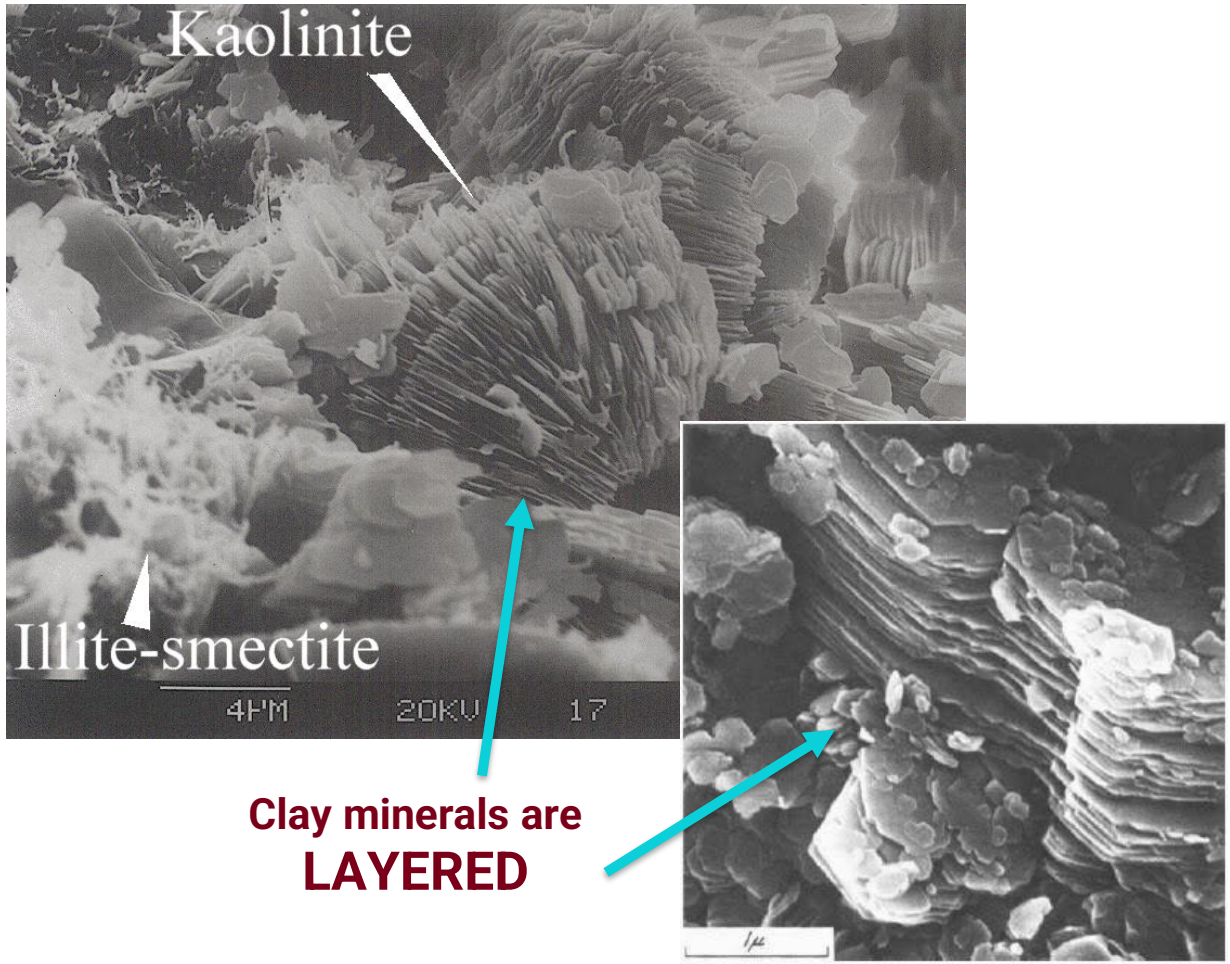
Clay Minerals





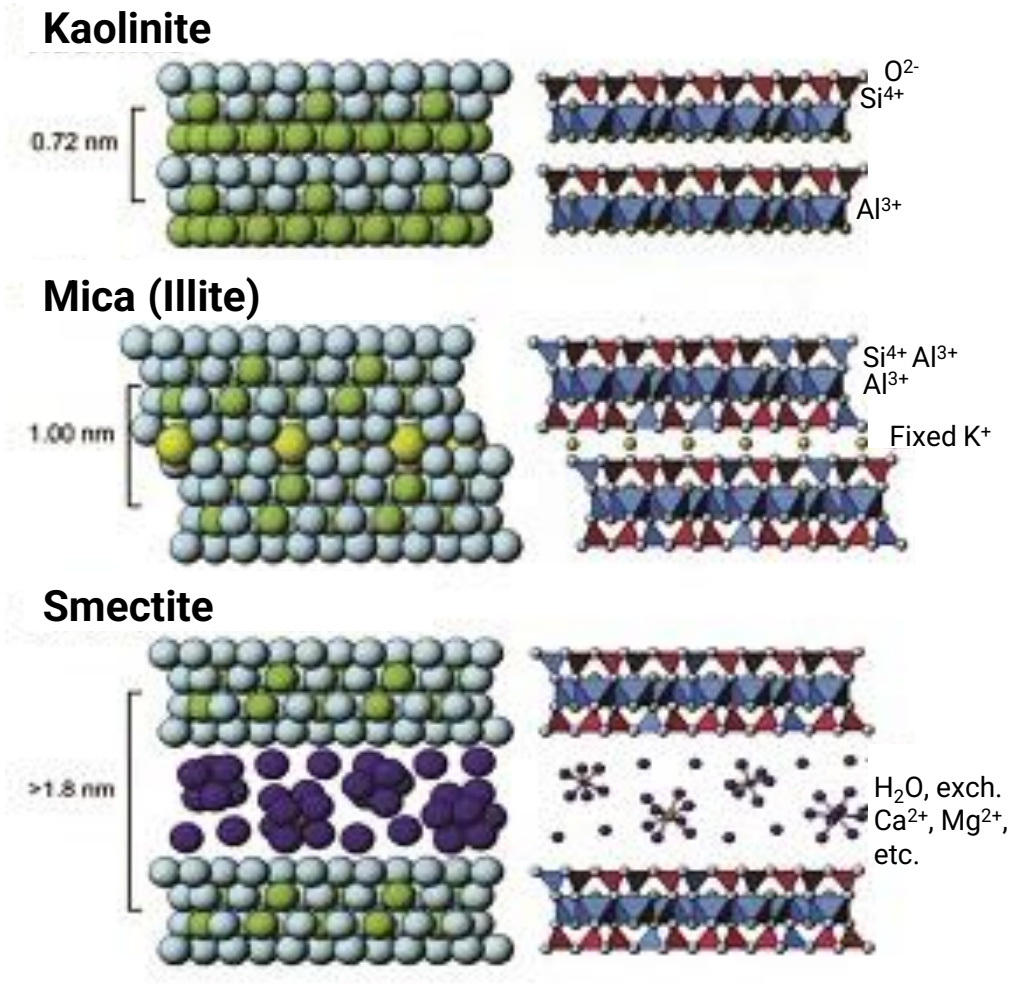
Clay Fraction





Clay minerals are
LAYERED

K Fertility and Clay Interlayers



1:1 Clay Minerals
CEC ~ 7 meq/100g (low)
No interlayer

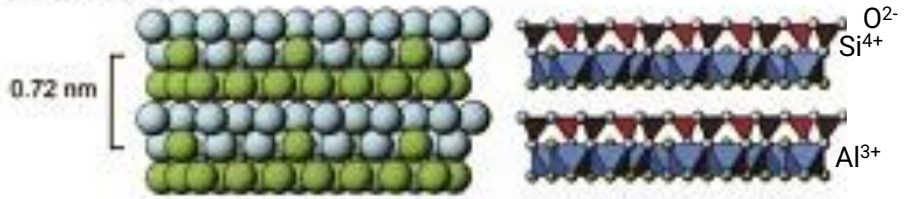
2:1 Clay Minerals
CEC ~ 40 meq/100g (medium)
Can trap (fix) K +

2:1 Clay Minerals
CEC ~ 70-120 meq/100g (high)
Can trap or release K

Image: SSSA K-12 Soil Science Teacher Resources, Soil Mineralogy

K Fertility and Clay Interlayers

Kaolinite



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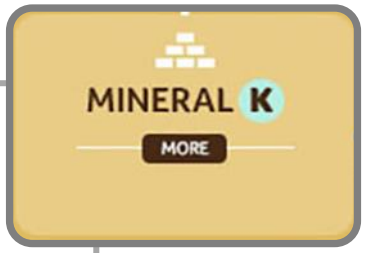
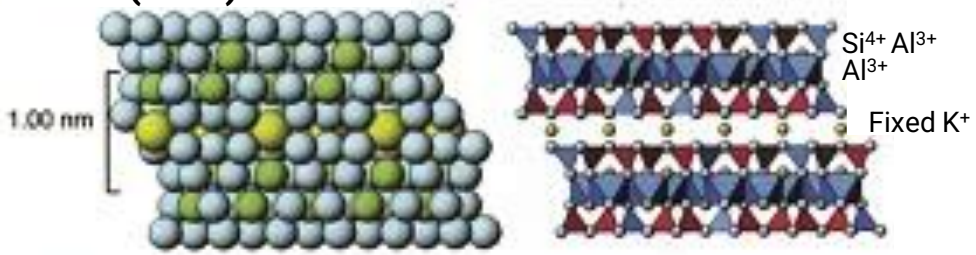
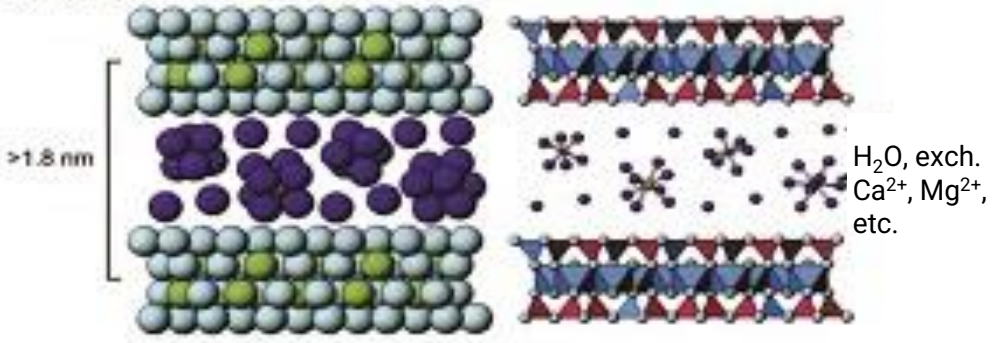


Mica (Illite)



2:1 Clay Minerals
CEC ~ 40 meq/100g (medium)
Can trap (fix) K +

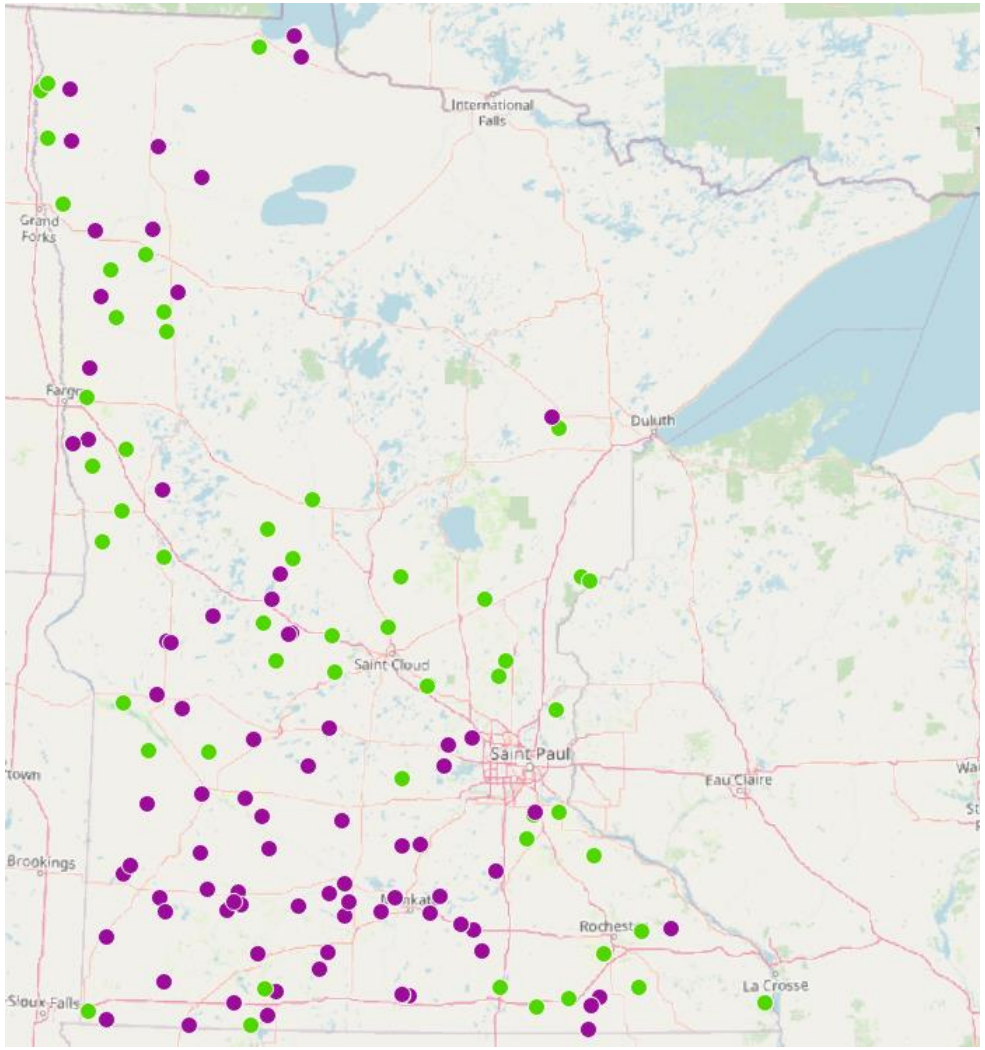
Smectite



2:1 Clay Minerals
CEC ~ 70-120 meq/100g (high)
Can trap or release K

Image: SSSA K-12 Soil Science Teacher Resources, Soil Mineralogy

Ratio of Smectite to Illite



Clay Ratio = $\frac{\text{Smectite}}{\text{Illite}}$

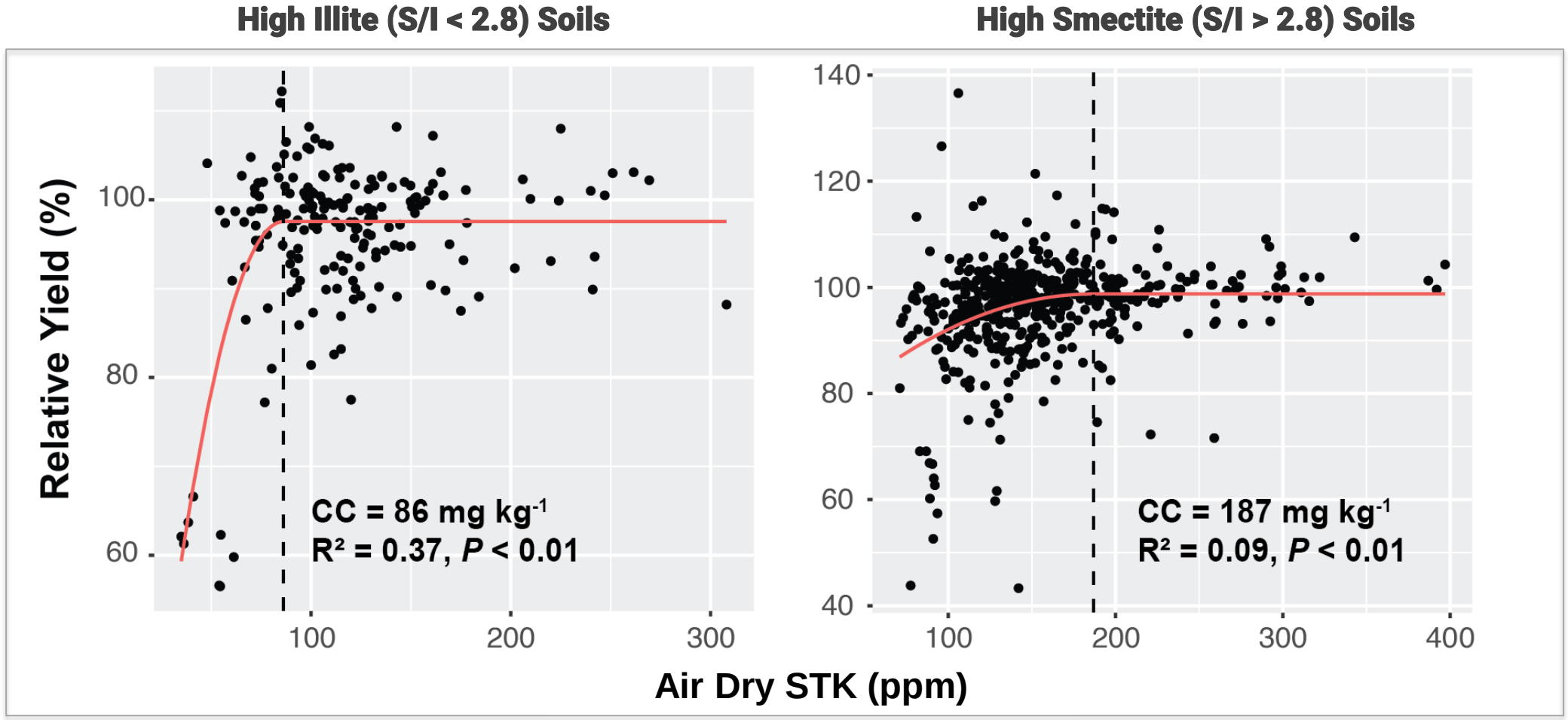
A method to capture the amount of smectite and illite in soils

Breakpoint in MN
S/I ratio = 2.8

- Higher ratio (S/I > 2.8): **More Smectite**
- Lower ratio (S/I < 2.8): **More Illite**

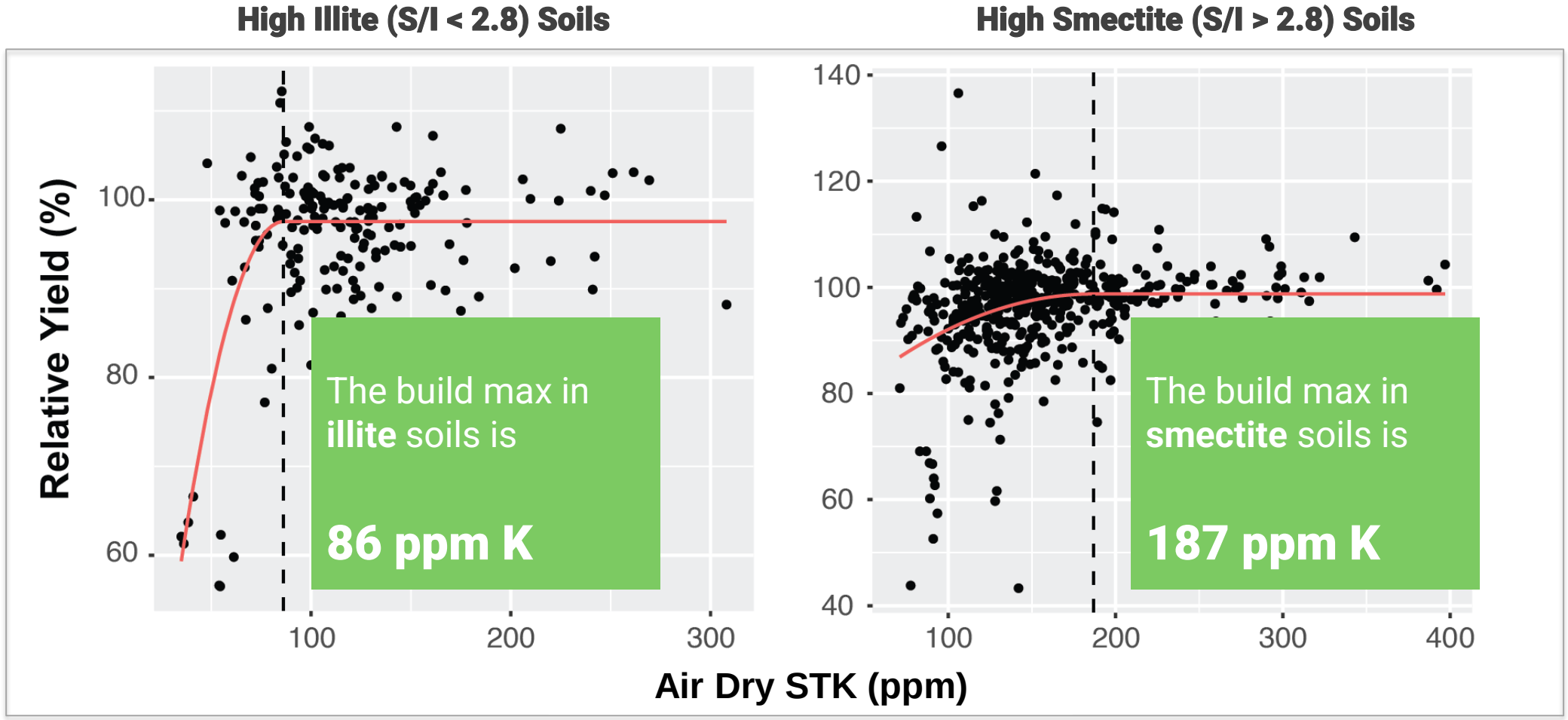
Critical K Values – cut off values for building soil K

Soil K value where there is no yield benefit to increasing the soil K level

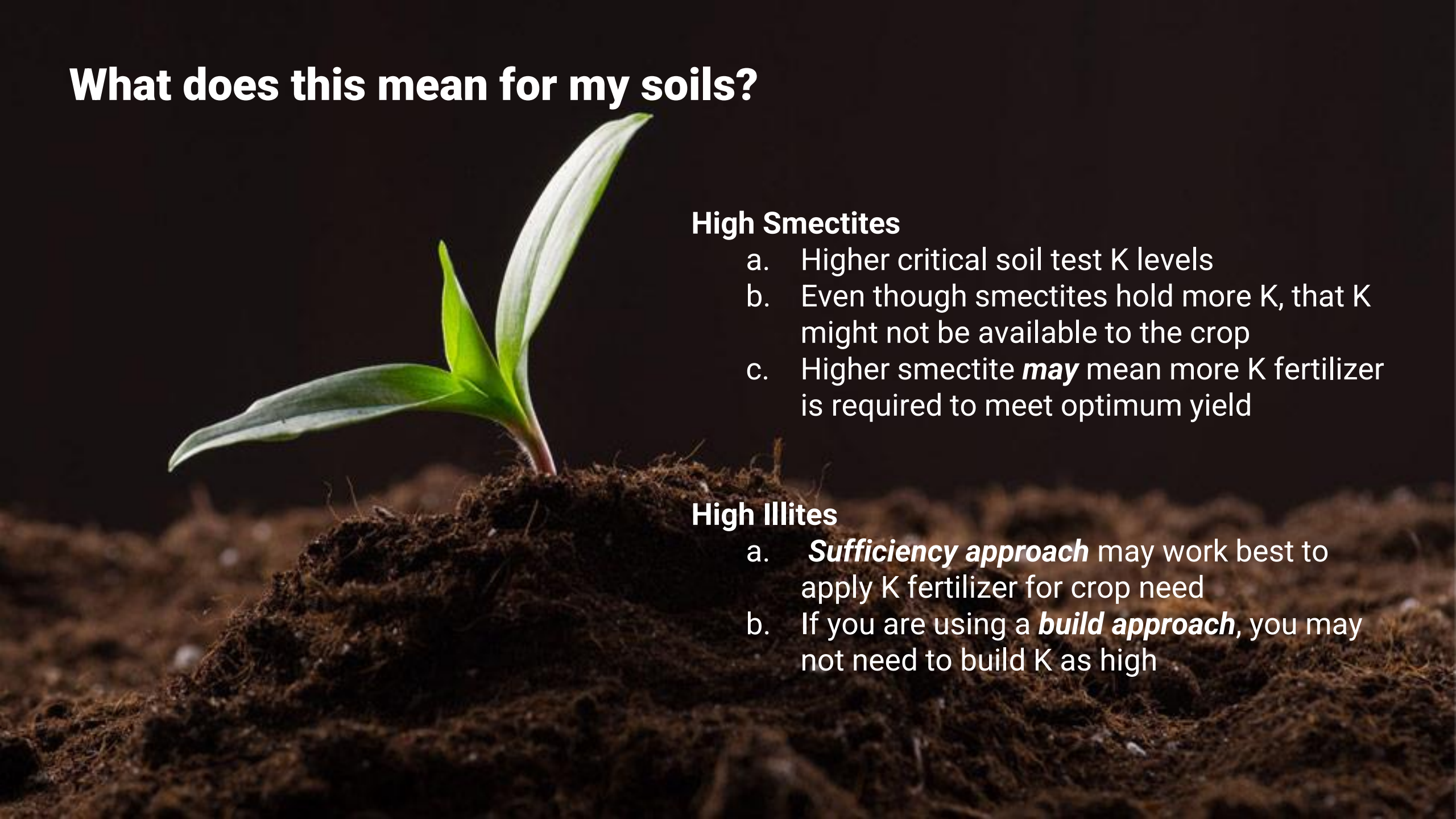


The Build Point (ppm K) for Soils

Soil K value where there is no yield benefit to increasing the soil K level



What does this mean for my soils?



High Smectites

a. Higher critical soil test K levels
b. Even though smectites hold more K, that K might not be available to the crop
c. Higher smectite ***may*** mean more K fertilizer is required to meet optimum yield

High Illites

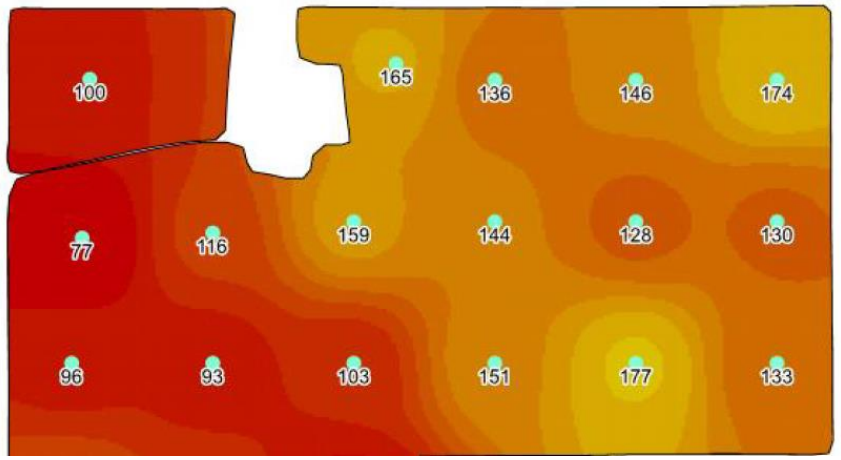
a. ***Sufficiency approach*** may work best to apply K fertilizer for crop need
b. If you are using a ***build approach***, you may not need to build K as high

Can I measure my own clay mineralogy?

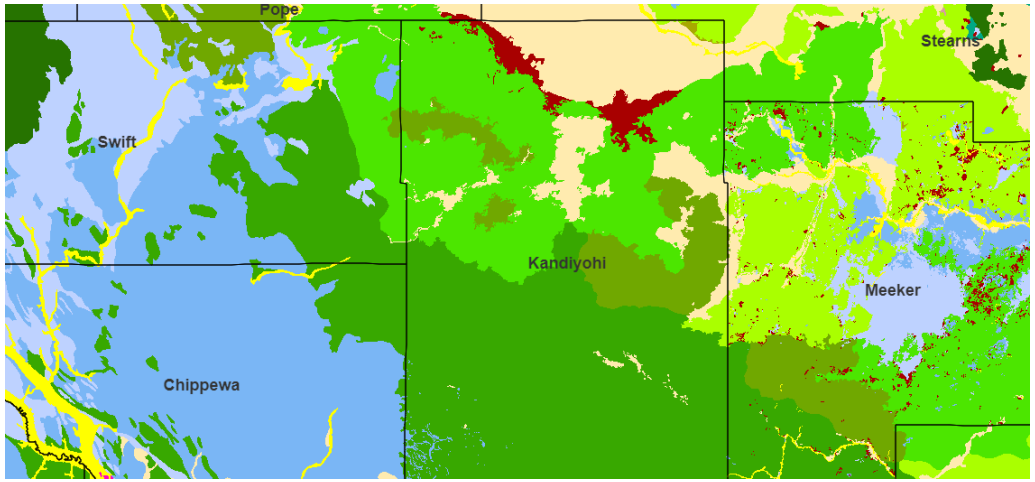
Clay Spatial Variability

- Determined by geological and soil forming factors
- On a square mile basis, not like a routine soil test
- Clay type will likely not vary between fields for an entire farm

- **Not affordable ~$300 per soil sample for mineralogy**

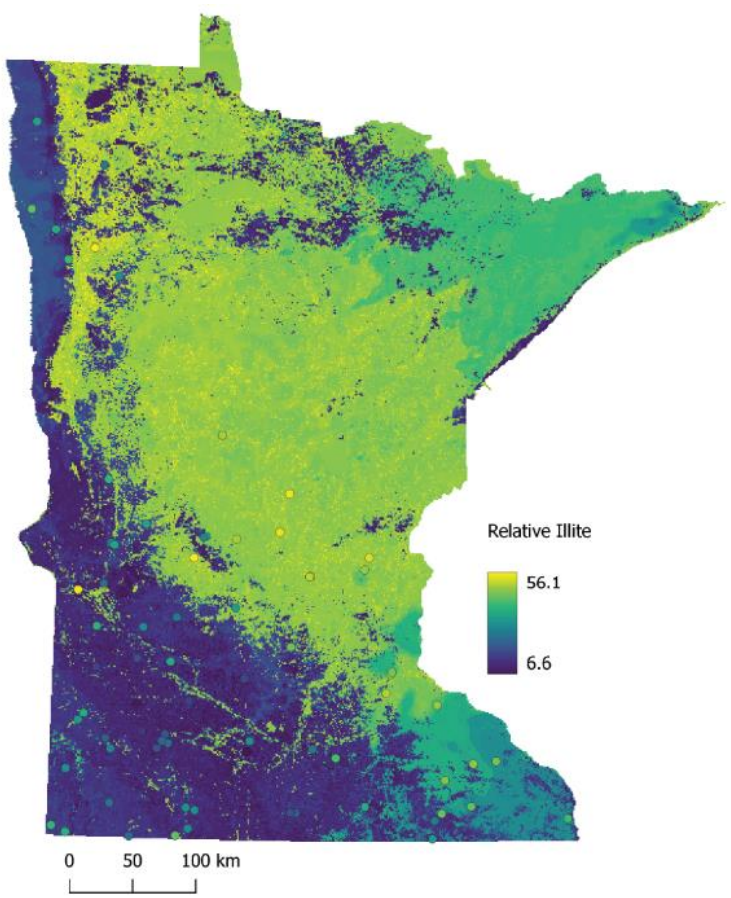


Soil Test K for Farm Field

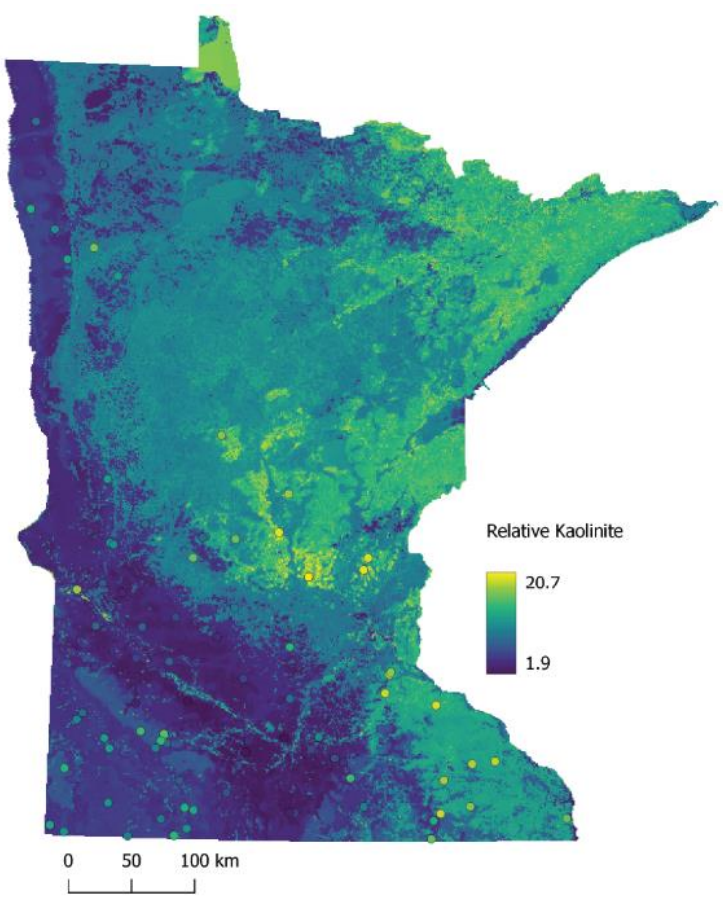


Geology on County Level for MN

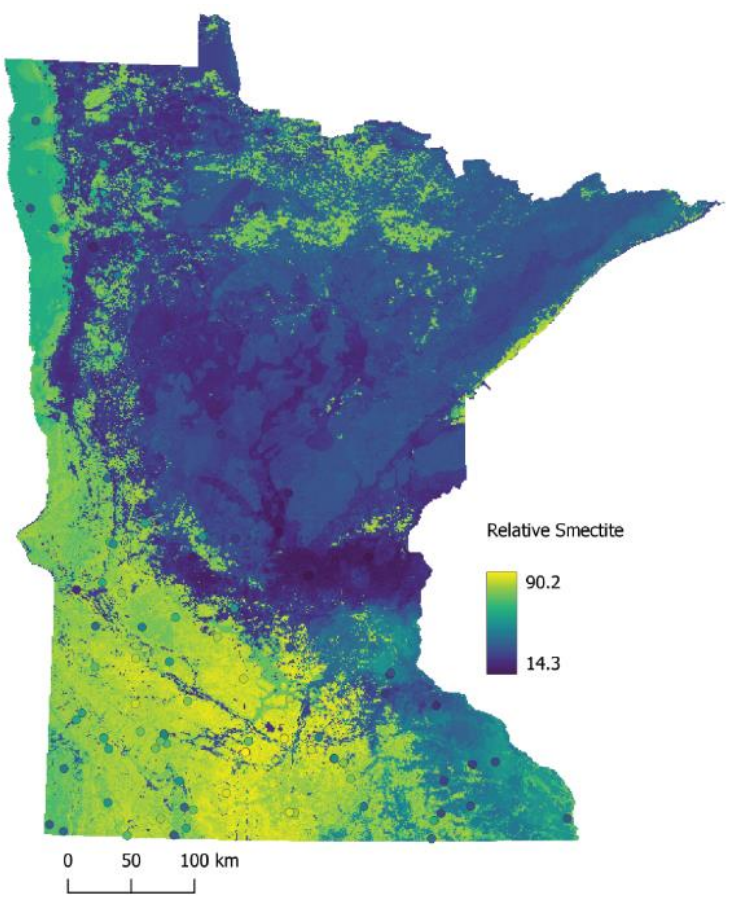
Clay Mineral Maps



Illite



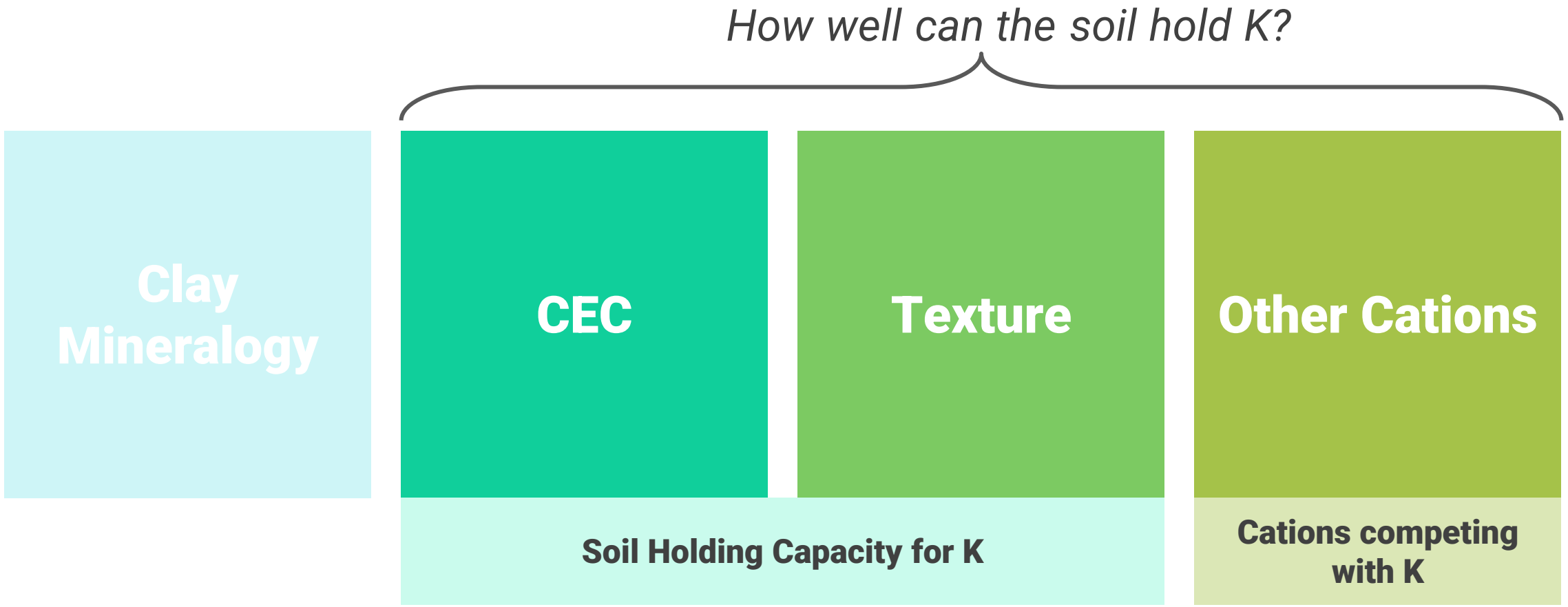
Kaolinite



Smectite

Factors influencing K Availability

Lab Study: Sorption and Release of K



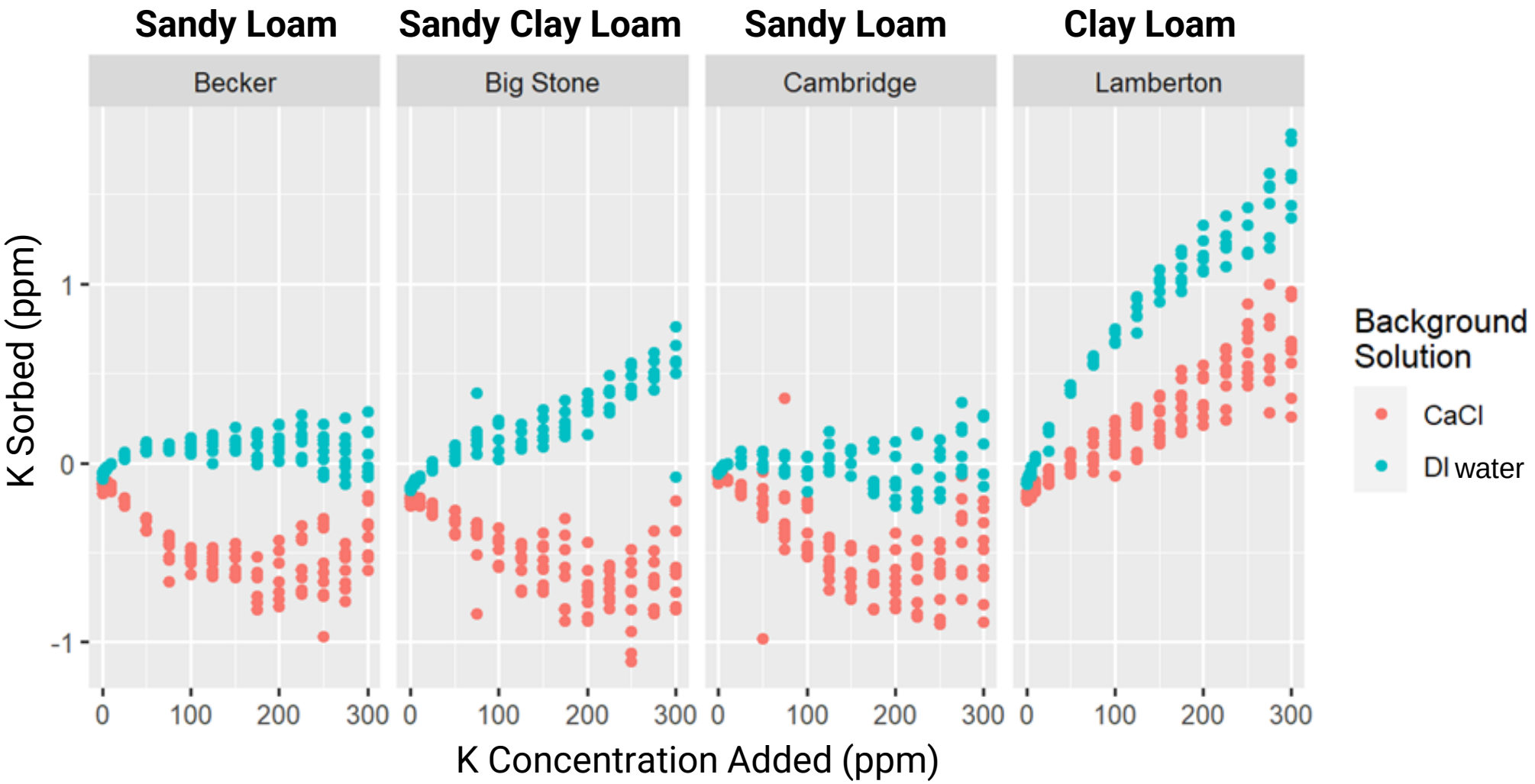
Lab Study: Sorption and Release of K

How well can the soil hold K?

Soil Holding Capacity for K

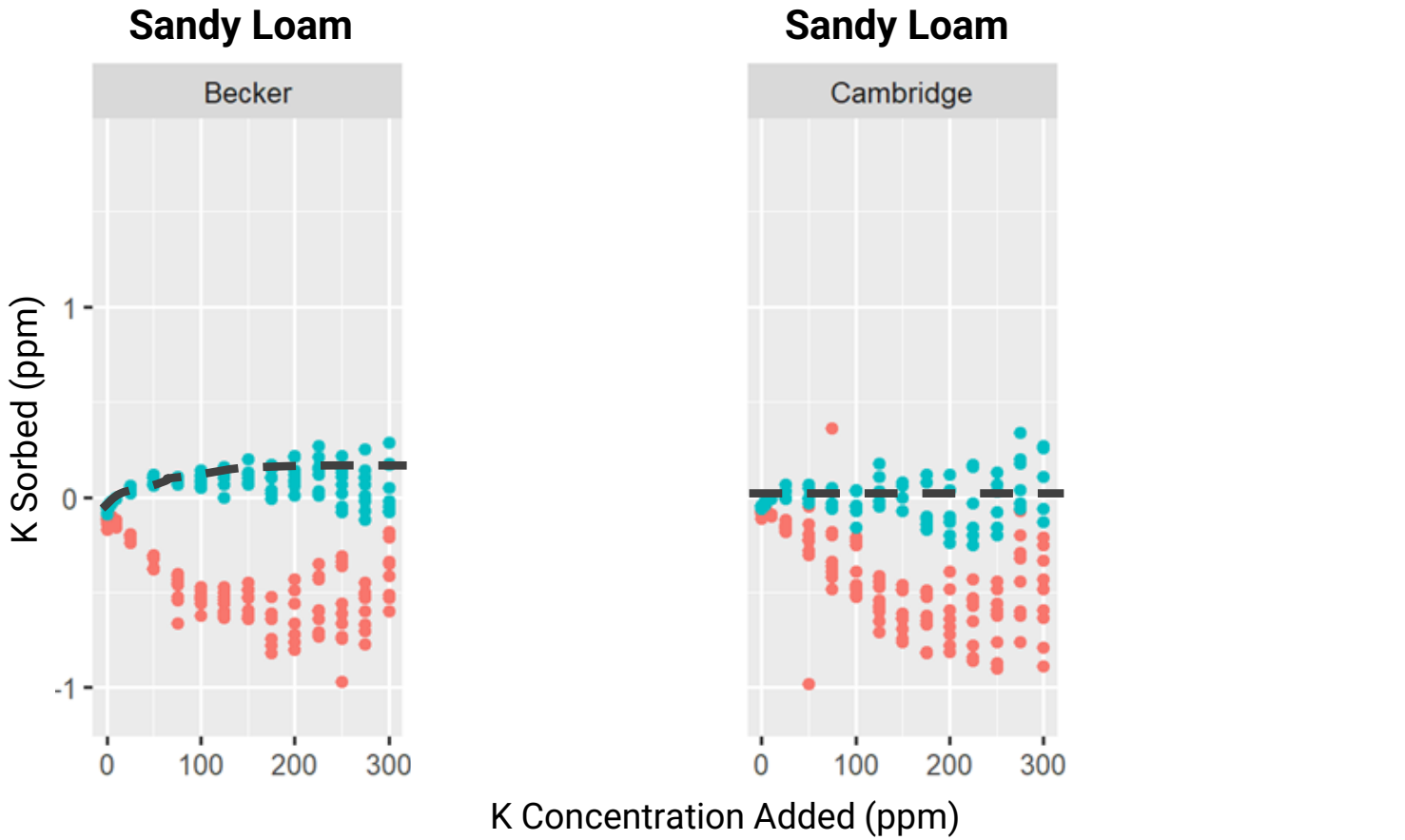
1. **Add K solution at various concentrations (0-300 ppm K) to soils**
2. **Measure how much K the soil “sorbs” or can hold**

Sorption of K



Sorption of K

1. The sandy soils could not “sorb” additional K (or minimal amounts)

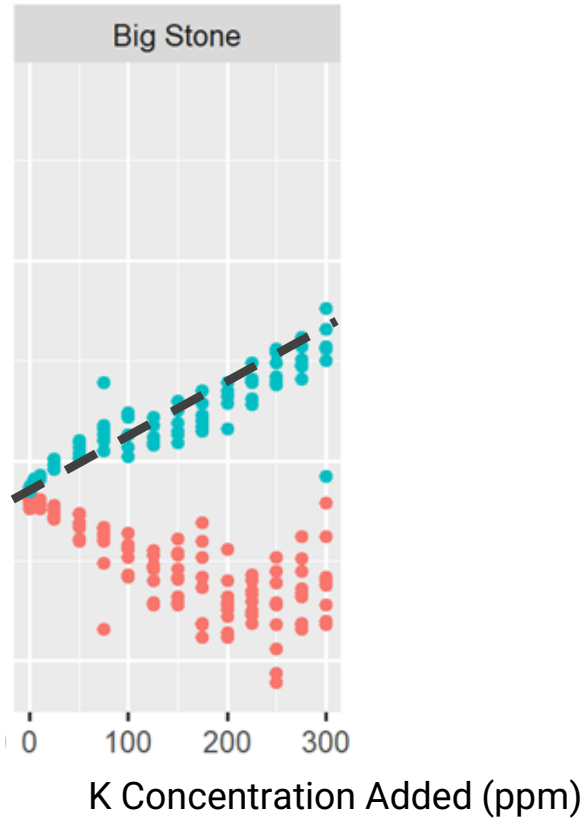


Sorption of K

1. The sandy soils could not “sorb” additional K (or minimal amounts)

2. A small amount of clay (sandy clay loam) increased K retention

Sandy Clay Loam



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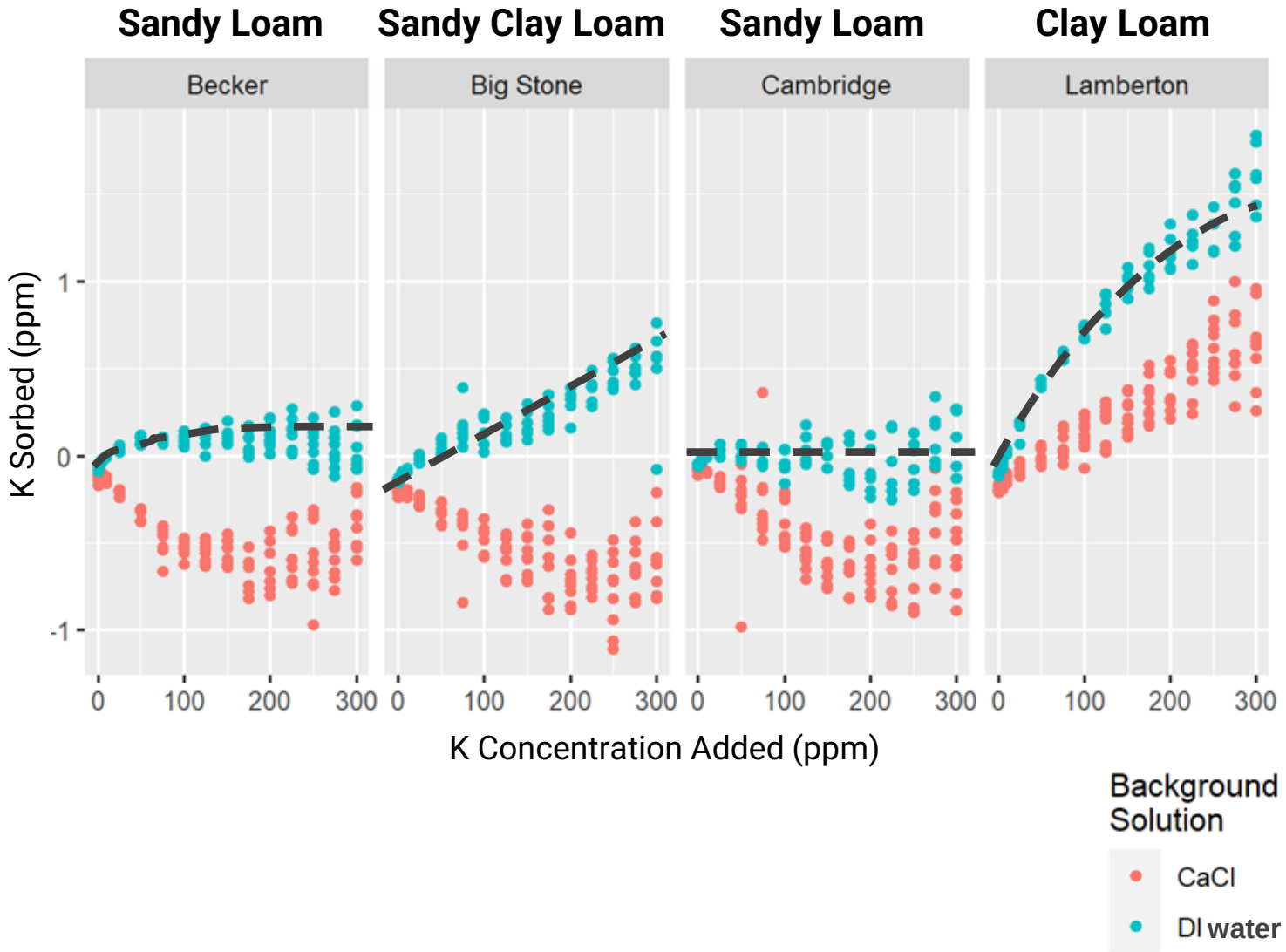
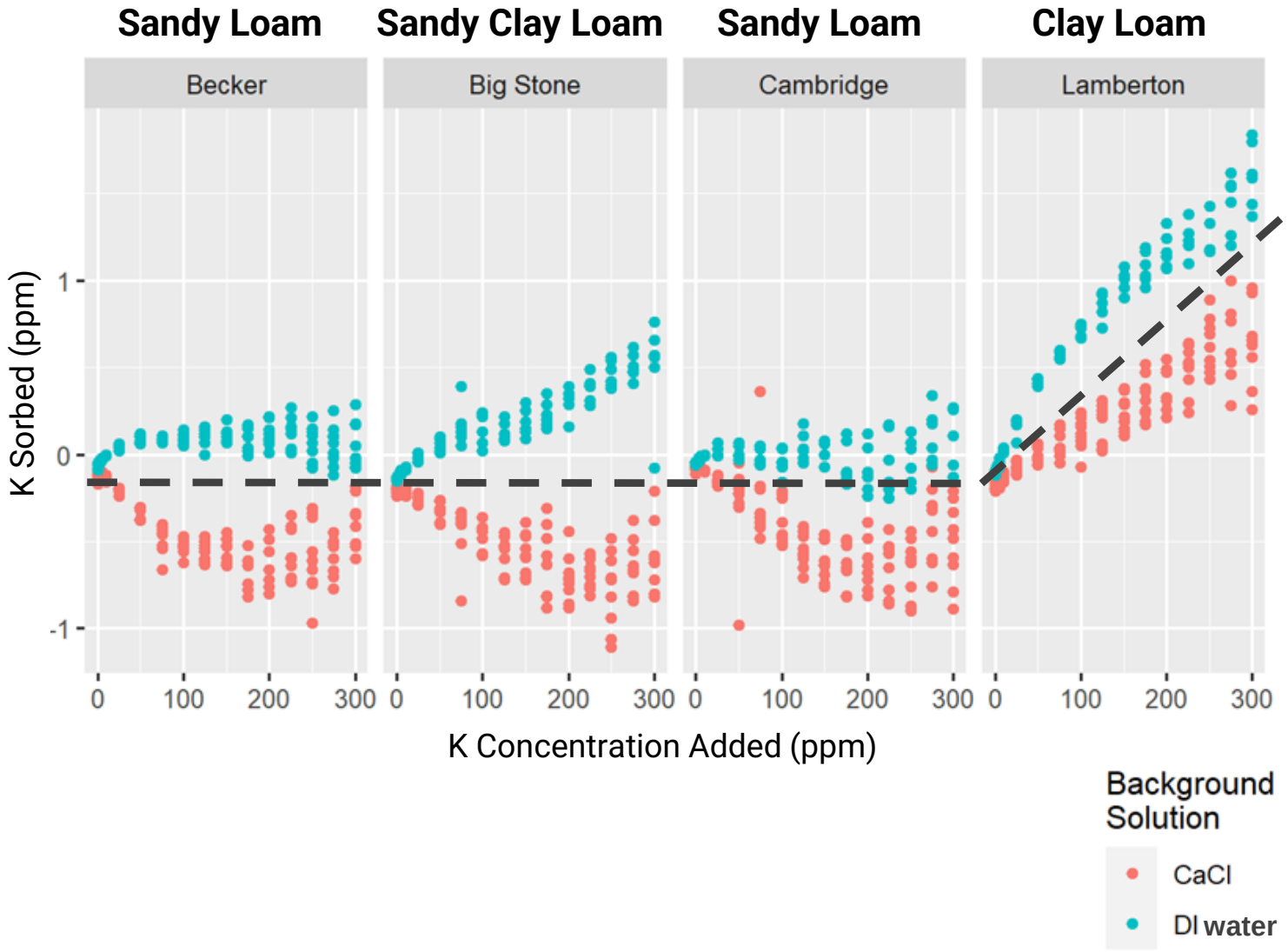


Sorption of K

1. The sandy soils could not “sorb” additional K (or minimal amounts)

2. A small amount of clay (sandy clay loam) increased K retention

3. The Ca2+ ion out competed the K+ ion (Ca was sorbed instead)



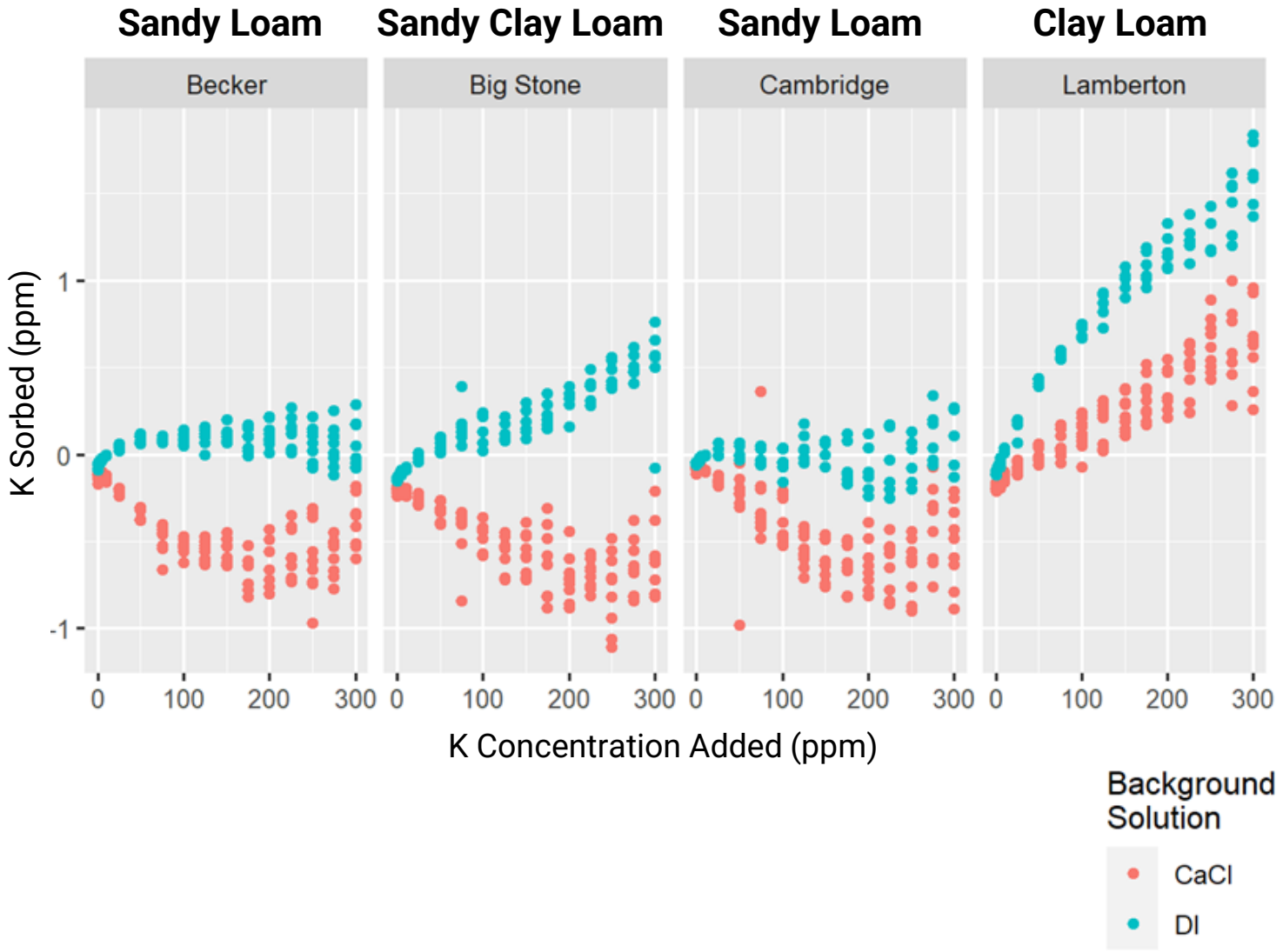
Sorption of K

1. The sandy soils could not “sorb” additional K (or minimal amounts)

2. A small amount of clay (sandy clay loam) increased K retention

3. The Ca2+ ion out competed the K+ ion (Ca was sorbed instead)

4. The clay soil was still able to sorb K+ and Ca2+



Factors influencing K Availability: Findings

Clay Mineralogy

- Smectite/Illite breaks at 2.8
- High smectites have higher build levels for for K

CEC

- Soils with higher CEC (smectites and clay dominant soils) are able to sorb K
- High CEC soils can maintain a higher build soil test K ppm

Texture

- Clay soils can retain and “sorb” K even with Ca present
- Sands have a limit in K sorption and can’t sorb K with Ca^{2+}

Other Cations

- Cations with a 2+ charge can outcompete K

What's Next for K Recommendations

- Continue to use soybean and corn K guidelines (updated in 2019)
- Keep an eye out for possible updates to separate K recs for sandy soils and/or illitic soils.
  - More study needed
- Do **not** change your fertility practices based on Ca, Mg, or cation ratios

Table 5. Potash fertilizer guidelines for soybean production in Minnesota

YIELD GOAL	Potassium (K) Soil Test (ppm)				
	0-50	51-100	101-150	151-200	200+
--bu./ac--	----------lbs. K_2O / acre to apply*----------				
< 30	55	35	20	15	0
30-39	65	50	30	20	0
40-49	80	60	40	25	0
50-59	100	75	50	30	0
60-69	110	85	60	35	0
70+	120	95	70	40	0

*Use the following equation to calculate potash fertilizer guidelines for specific yield goals and specific soil test values for K:
$K_2O_{Recommended}$ = [2.0 - (0.0088) (K Soil Test, ppm)](Yield Goal)

Table 11. Broadcast (Bdcst) and band potash guidelines for corn production in Minnesota.*

	Soil test K (ppm)									
	Very Low		Low		Medium		High		Very High	
Expected	0-50		51-100		101-150		151-200		200+	
Yield	Bdcst	Band	Bdcst	Band	Bdcst	Band	Bdcst	Band	Bdcst	Band
bu/acre	---------- K_2O per acre to apply (lbs per acre) ----------									
151 - 175	160	75	115	60	70	45	20	10-15	0	10-15
176 – 200	185	90	135	70	80	50	25	10-15	0	10-15
201 – 225	210	105	155	80	90	55	30	10-15	0	10-15
226 -250	235	120	165	85	100	60	35	10-15	0	10-15
250 +	255	130	180	90	110	65	40	15-20	0	10-15

** Use one of the following equations if a K_2O guideline for a specific soil test value and a specific expected yield is desired.*
$K_2O_{suggested}$ = [1.12 - 0.0056 (Soil Test K, ppm)] (expected yield)
No potash fertilizer is suggested if the soil test for K is 200 ppm or greater.

Thank you!
Questions

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