



PURIC and NUTRIO Products

Greg Binford

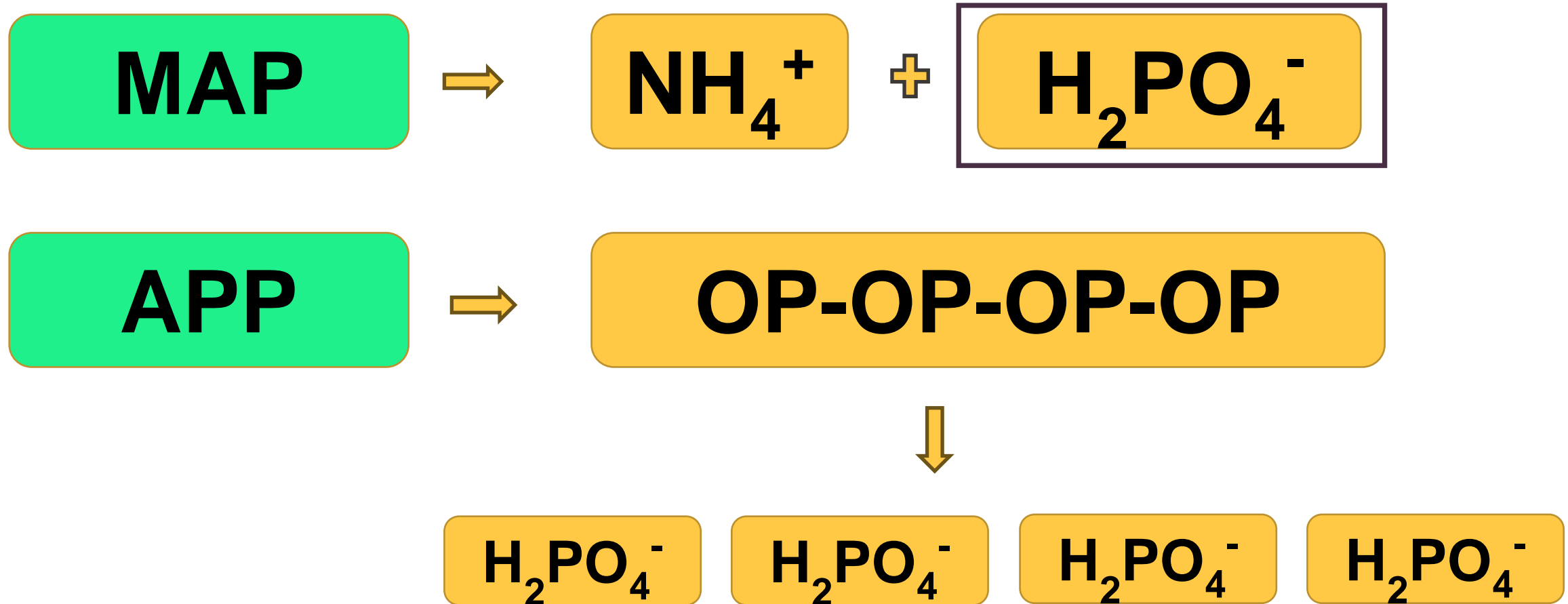
Director of Advanced Agronomy

ADVANCED AGRONOMY
BOOTCAMP

PHOSPHORUS

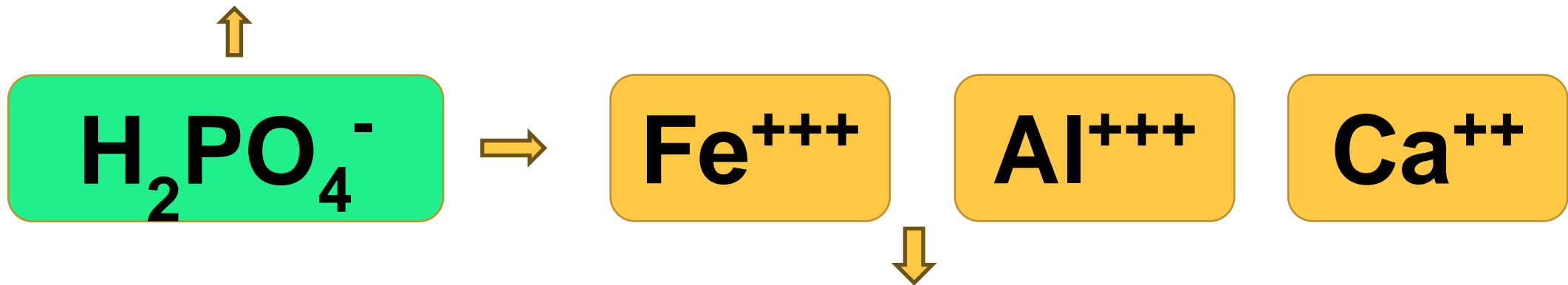


What Happens to P Fertilizer?



What Happens to P Fertilizer?

Plant Uptake = Main Goal



Fe-P

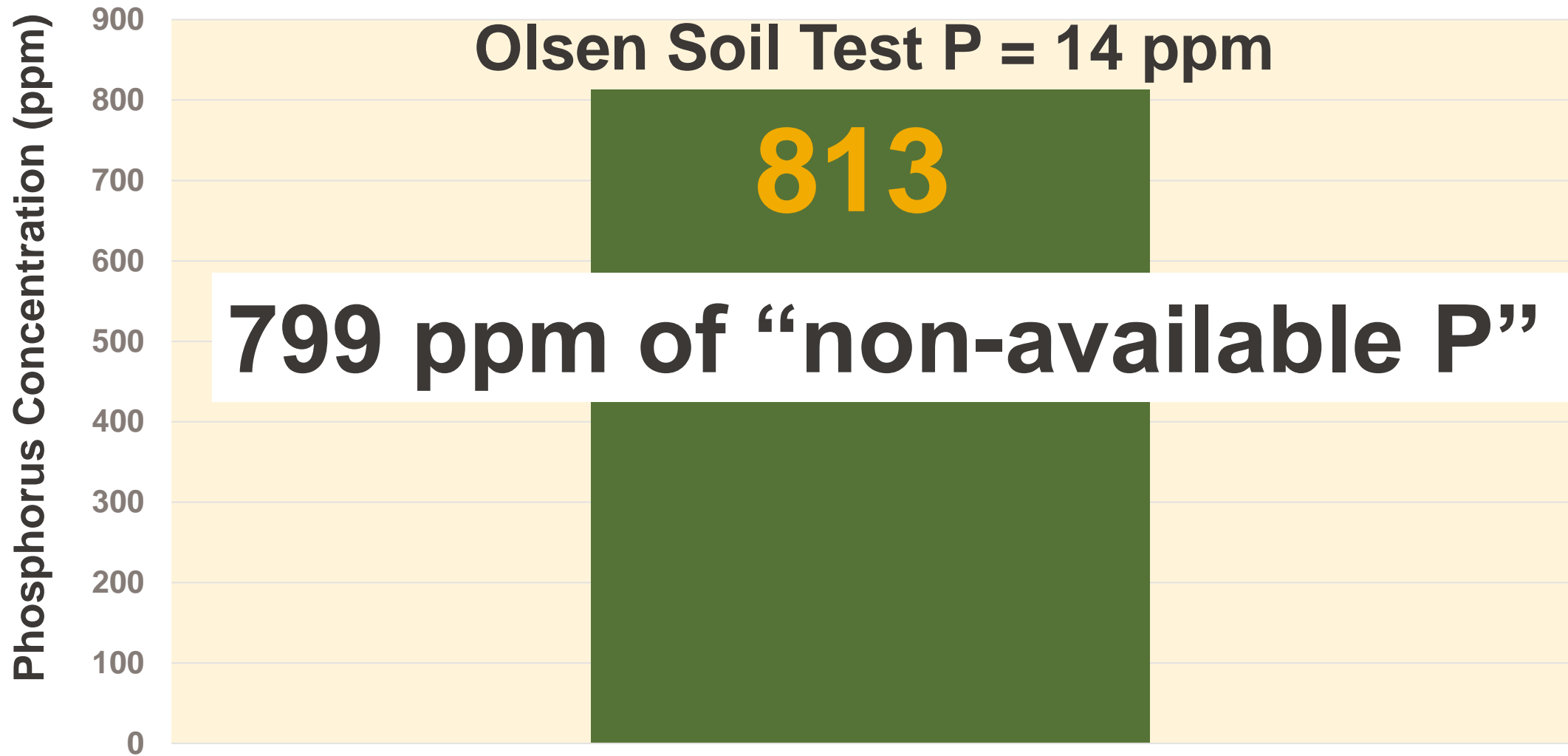
Al-P

Ca-P

Secondary Minerals = “Not Plant Available”



Soil Phosphorus Concentrations



**“The Challenge” –
Soils react with P
fertilizer making it
unavailable to plants!**



Impact P Availability in Soils?

Rate of P applied

Band Application

Nutrio Unlock

Humic & Fulvic Acids (PURIC)

Nutrio + Puric in combination

What is Humic & Fulvic Acid?

- Think...“Organic Matter”
- Organic matter = Beneficial to Soils
- Humic and Fulvic Acids = “Active” Portion
- Humic Acids = “Large” carbon molecules
- Fulvic Acids = “Small” carbon molecules
- Source = “Decomposed Organic Matter”



Leonardite = Common Source

- Leonardite = ancient “buried” swamp
- Leonardite is > 80% humic acid
- Not soluble in water!
- Not “Activated”!



Leonardite = “Not Activated”



**What is the process to
create HUMIC ACID that is
soluble or “activated”?**



Leonardite



Treat with alkali (base)



Leonardite



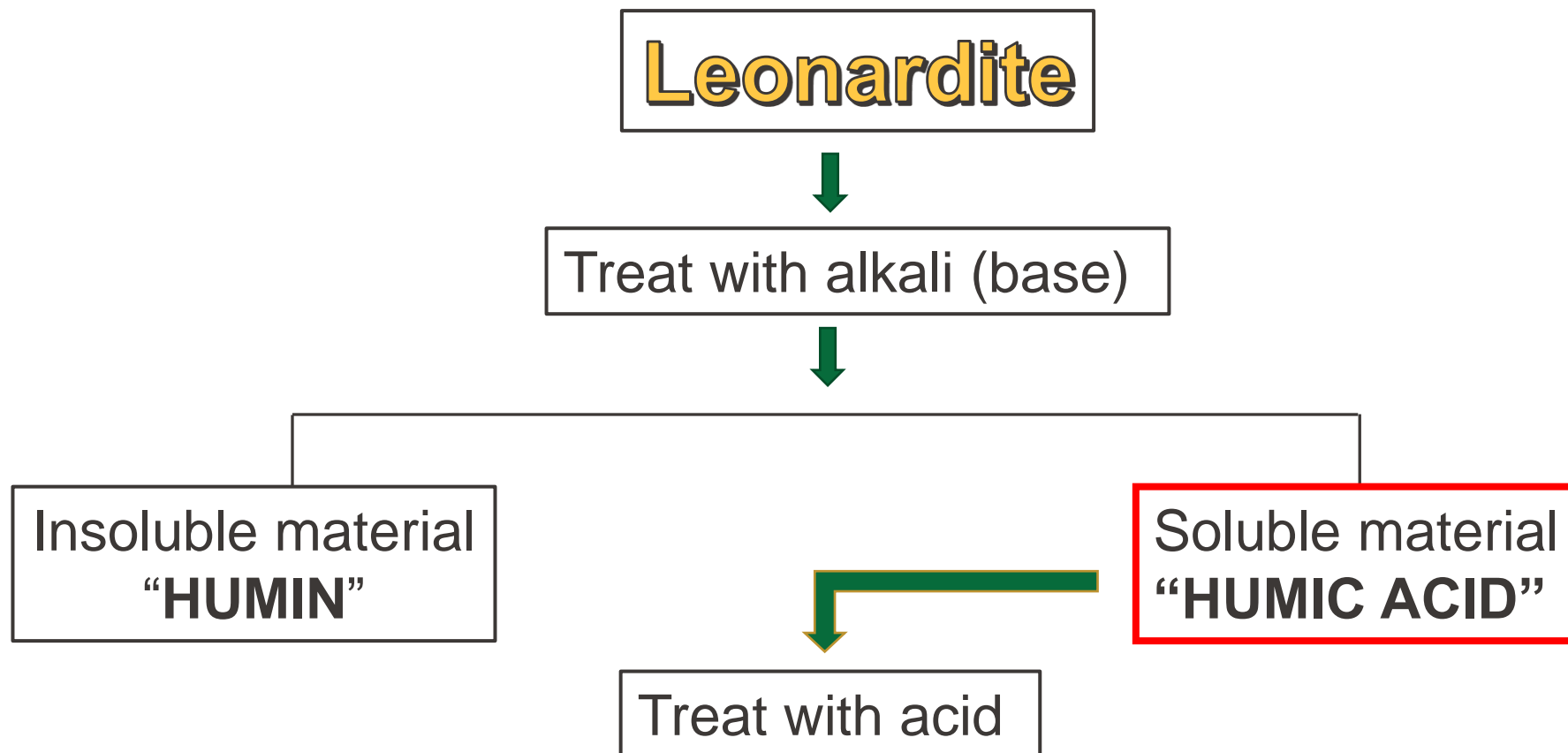
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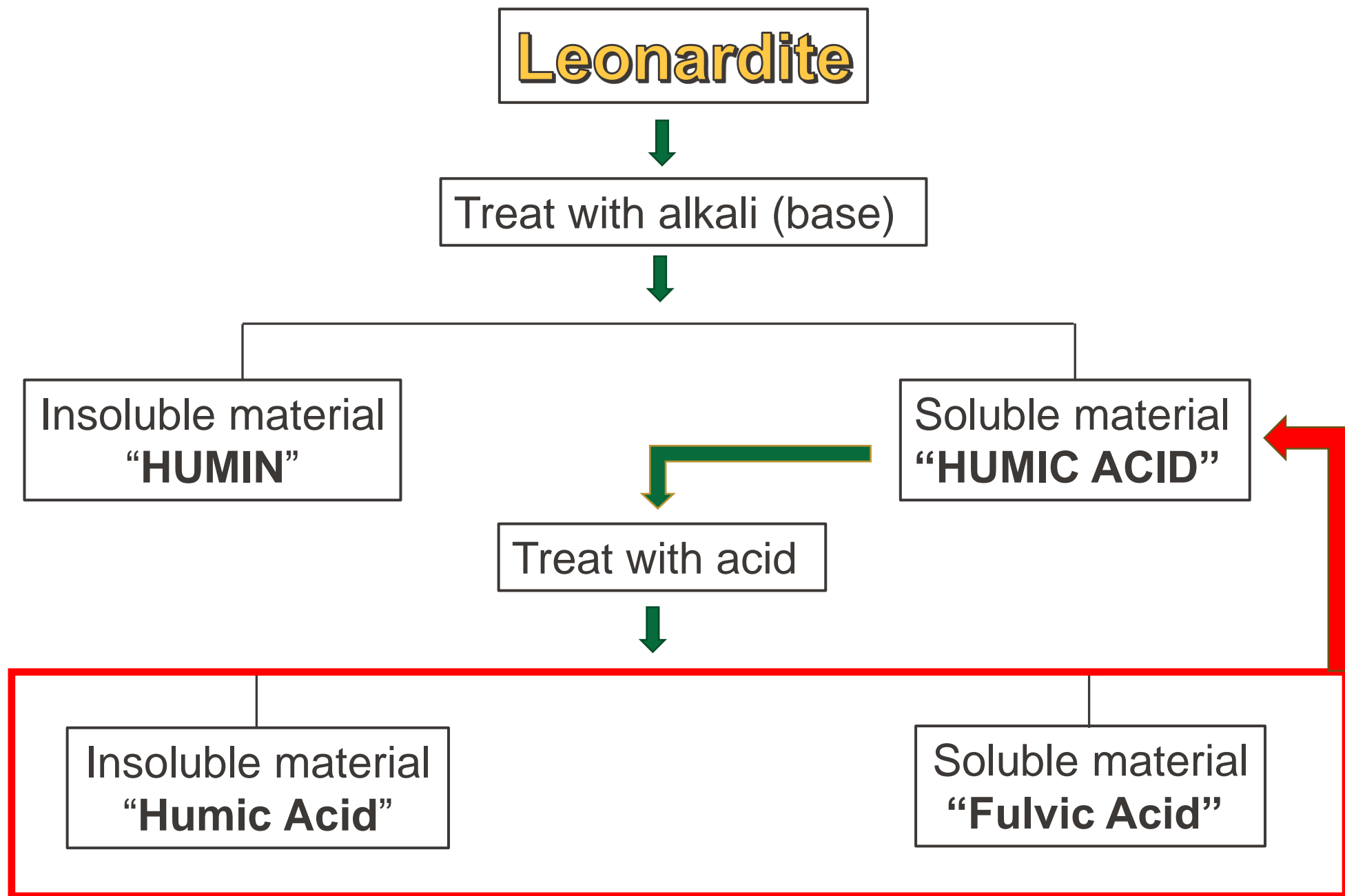


Insoluble material
“HUMIN”

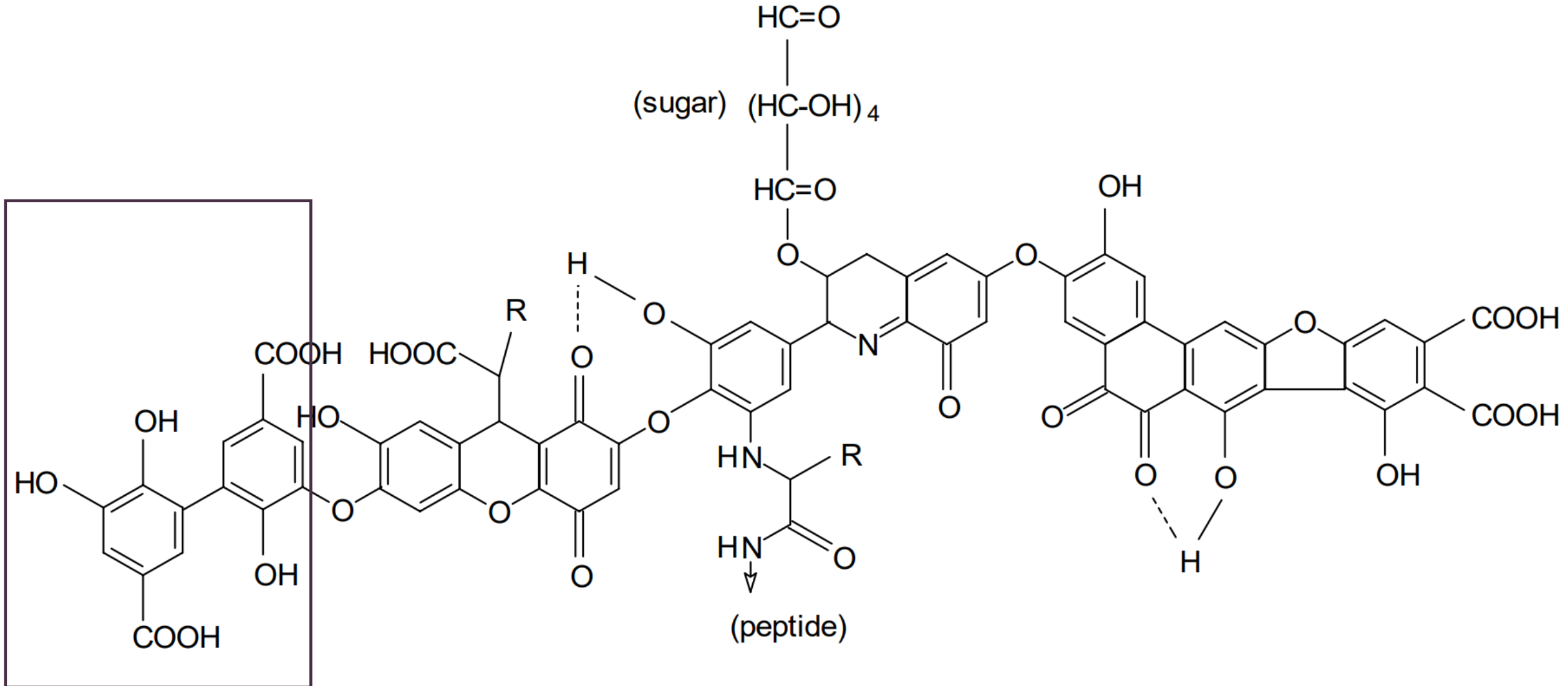
Soluble material
“HUMIC ACID”



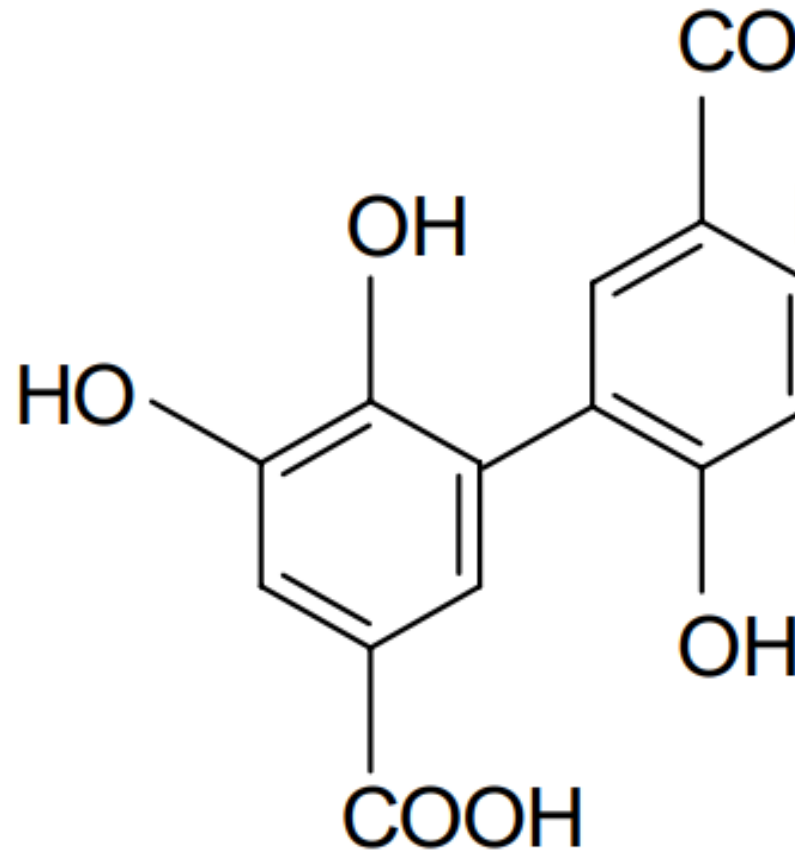




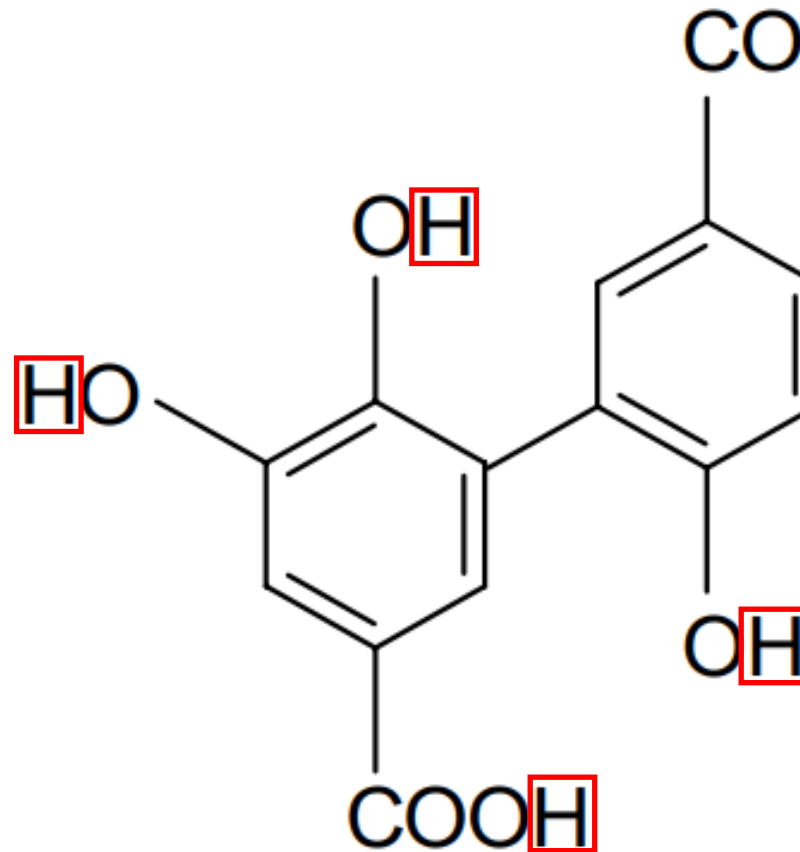
Part of a Humic Acid Molecule



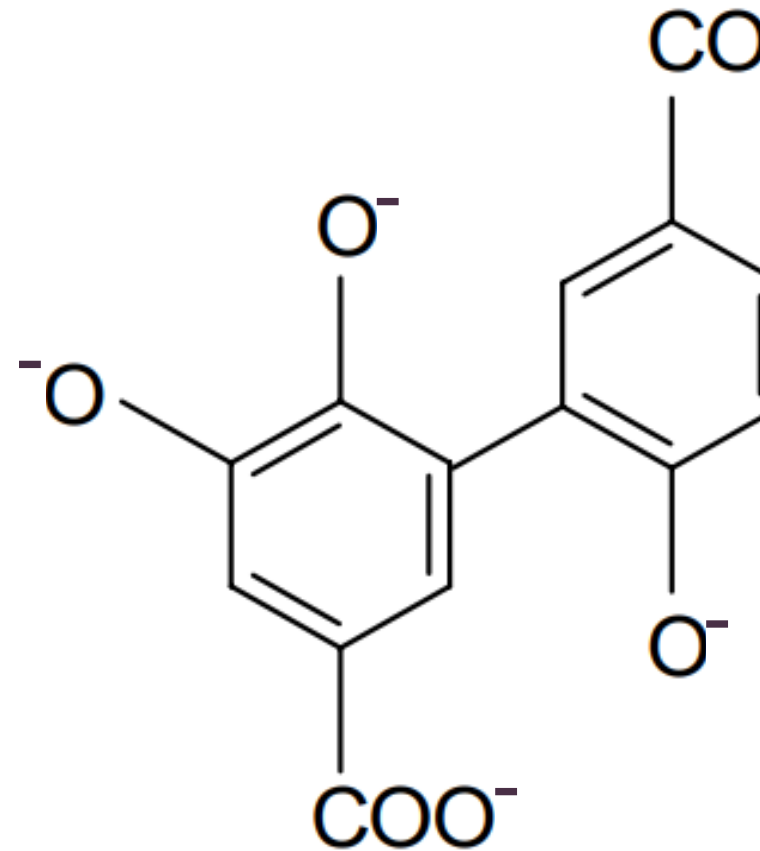
Activation of Humic Acid Molecule



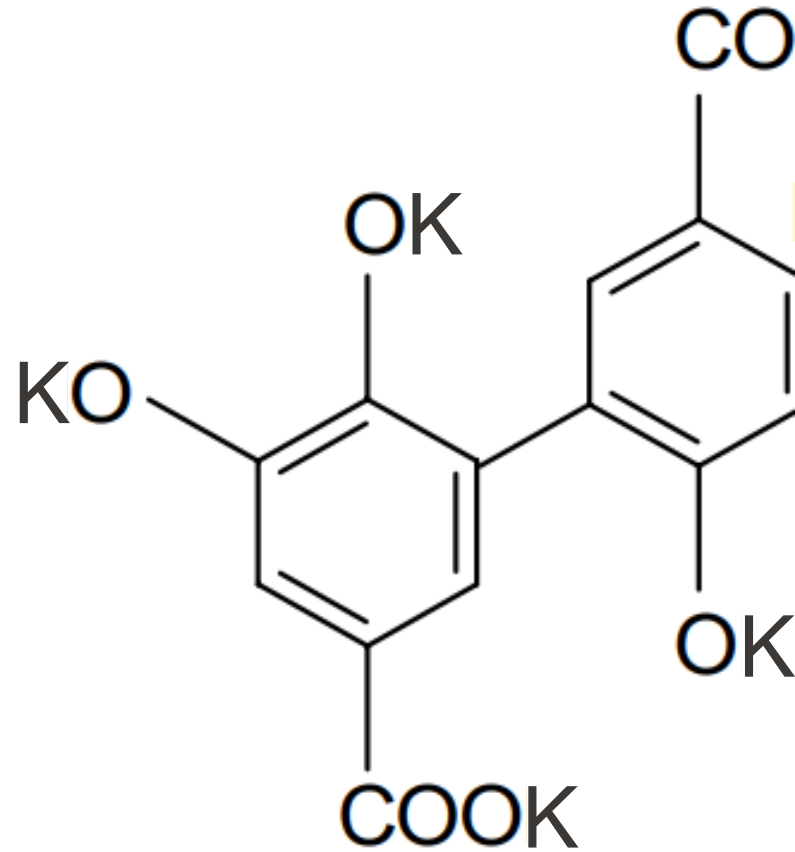
Activation of Humic Acid Molecule



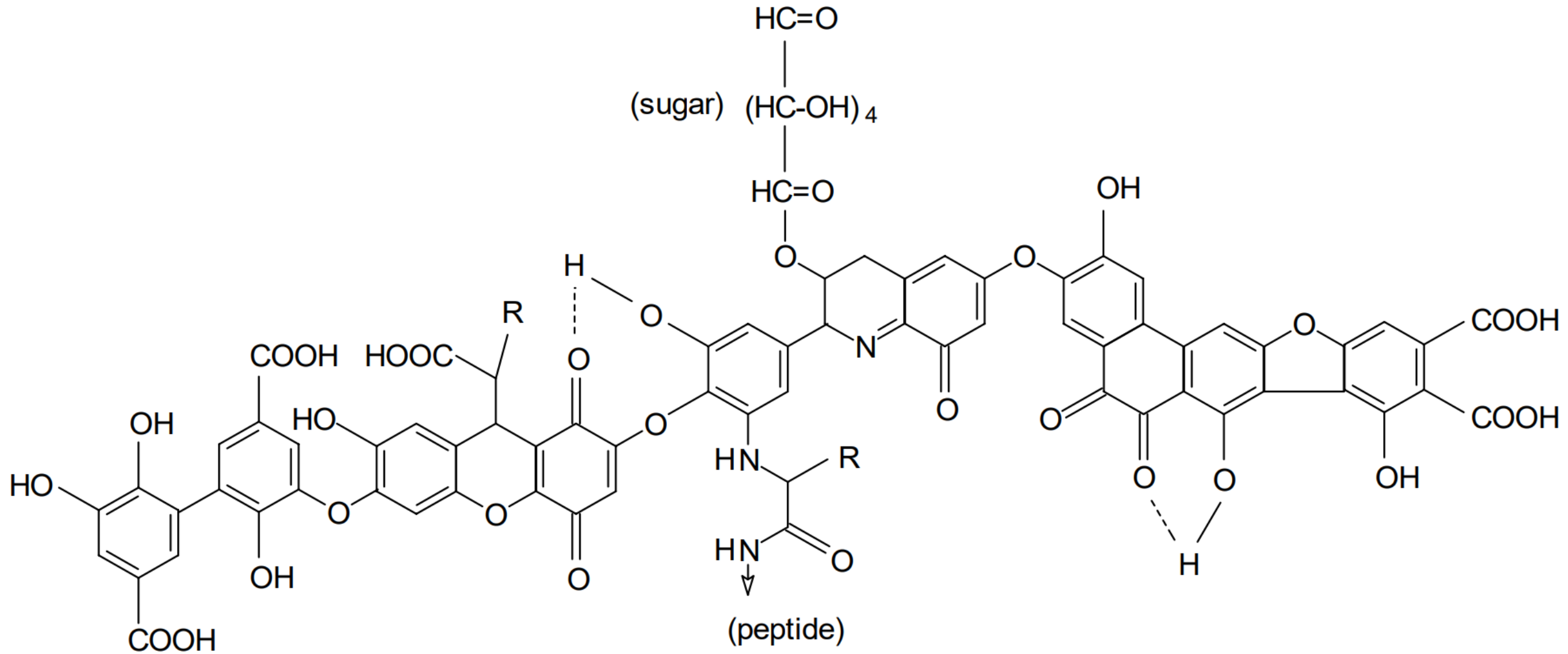
Activation of Humic Acid Molecule



Potassium Humate Molecule



Potassium Humate Molecule



Why Humic Acid?

- **Think – Organic Matter...**
- **Functional Groups – carboxyl & phenolic**
- **Nutrient-Holding Capacity (CEC)**
- **Water-Holding Capacity**
- **Stimulation of plant growth (roots & shoots)**
- **Stimulation of soil microbes**



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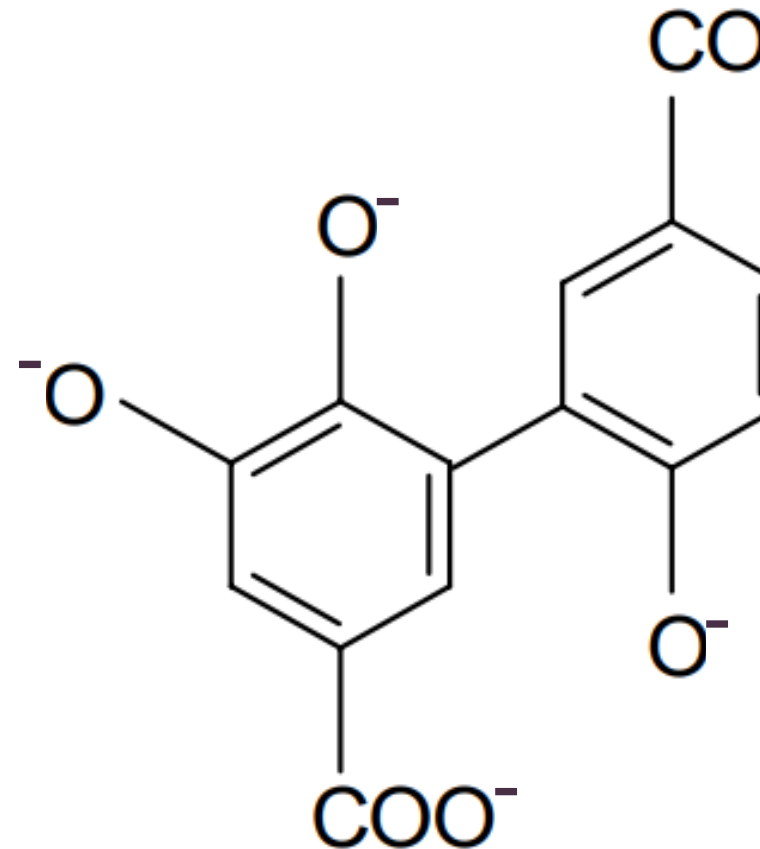


Cation Exchange Capacity

K⁺

Ca⁺⁺

Mg⁺⁺



Na⁺

Al⁺⁺⁺

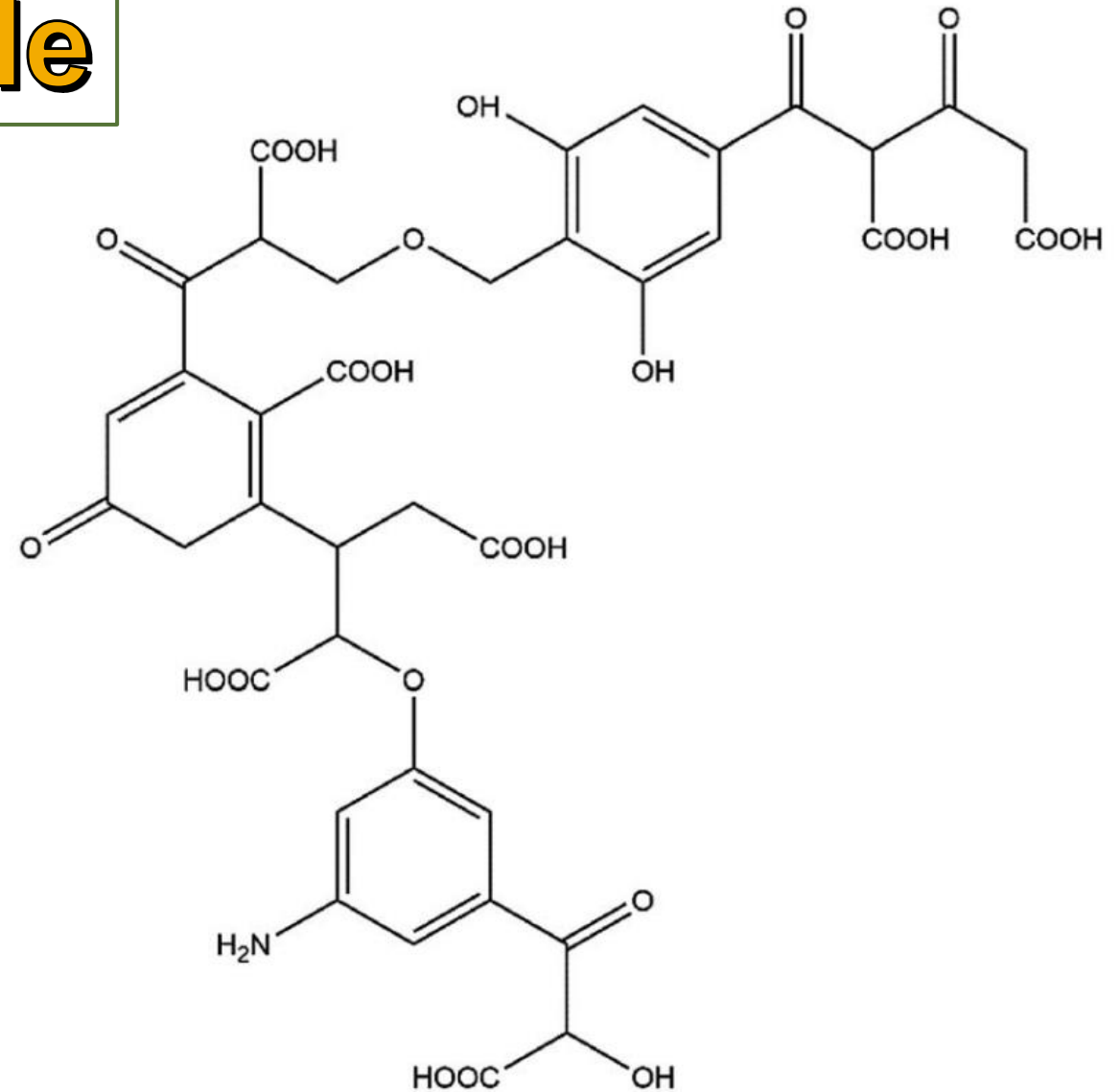


Fulvic Acid Molecule



MW = 886

- 1) More functional groups
- 2) Smaller than humics
- 3) Root & Leaf uptake
- 4) Brown/Amber in color



Fulvic Acid		Humic Acid		Humic
Light Yellow	Yellow Brown	Dark Brown	Grey-Black	Black

	—————	Increase in Intensity of Color	—————→	
	—————	Increase in Polymerization	—————→	
2,000	—————	Increase in Molecular Weight	—————→	300,000 ?
45%	—————	Increase in Carbon Content	—————→	62%
48%	—————	Decrease in Oxygen Content	—————→	30%
1,400	—————	Decrease in Exchange acidity	—————→	500
	—————	Decrease in solubility	—————→	



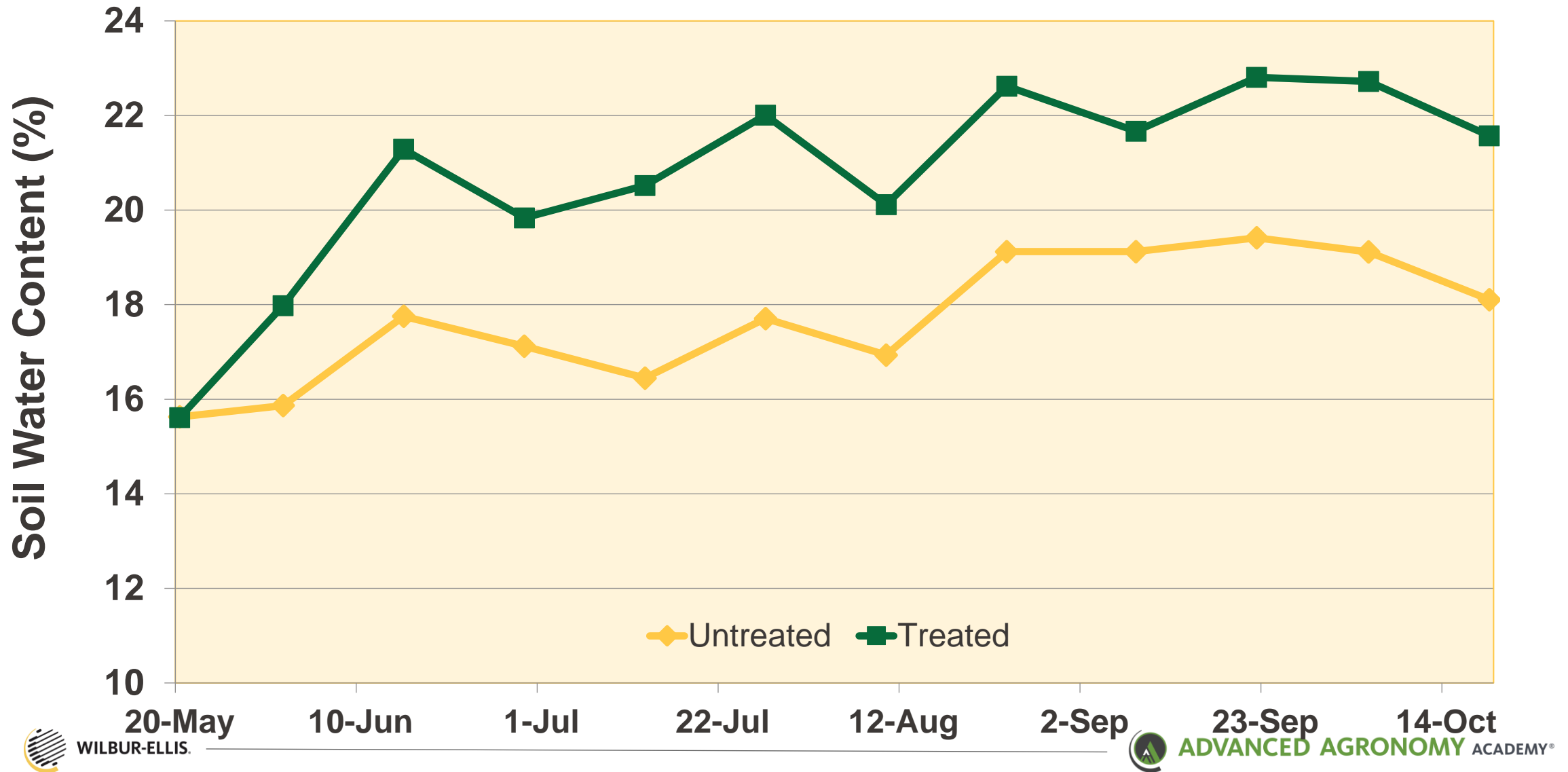
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Puric Salute + Nutrio – 12 Apps

University of California-Riverside Turf Study – Nutrio @ 16 oz/ac & Puric Salute @ 64 oz/ac per application



WILBUR-ELLIS



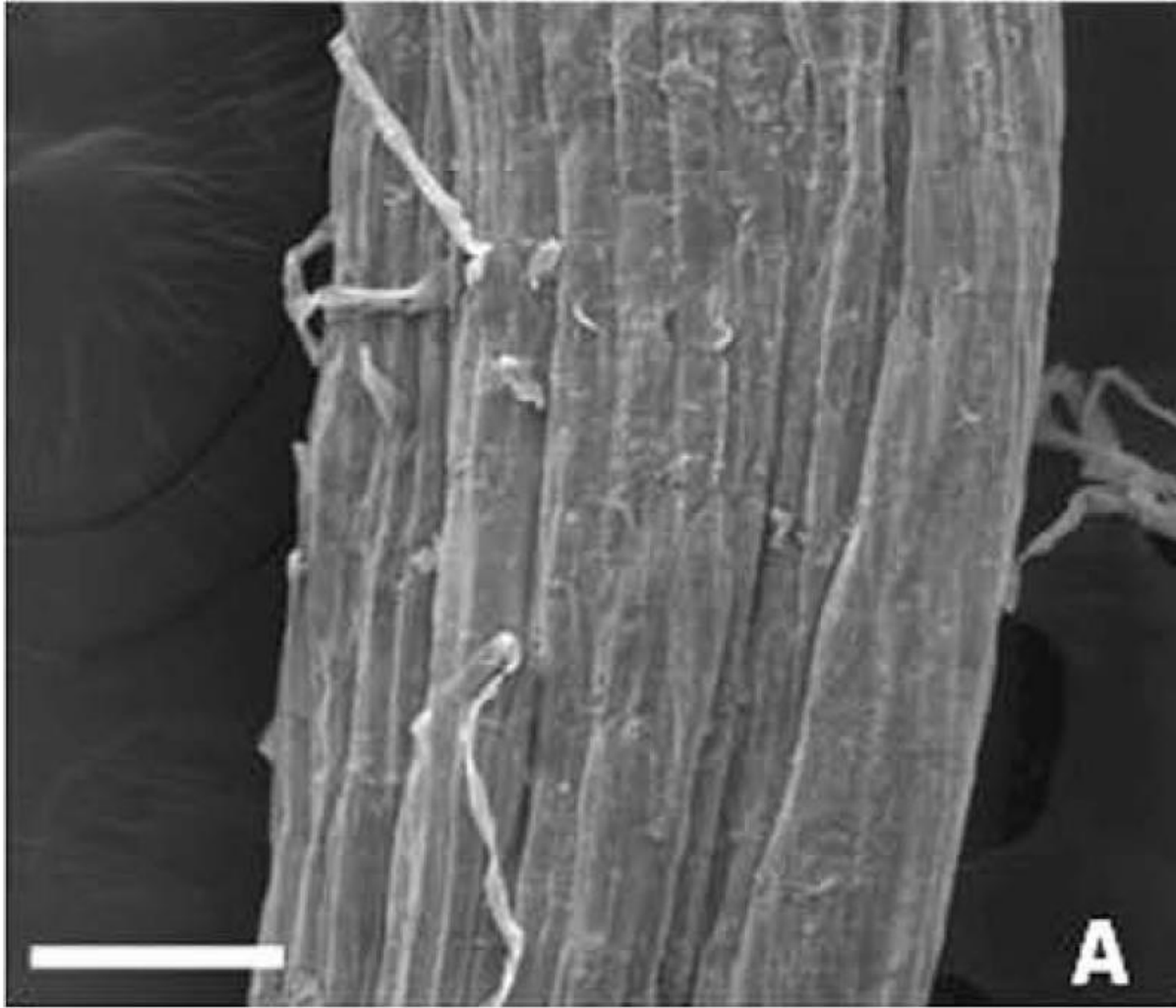
ADVANCED AGRONOMY ACADEMY®

Why Humic Acid?

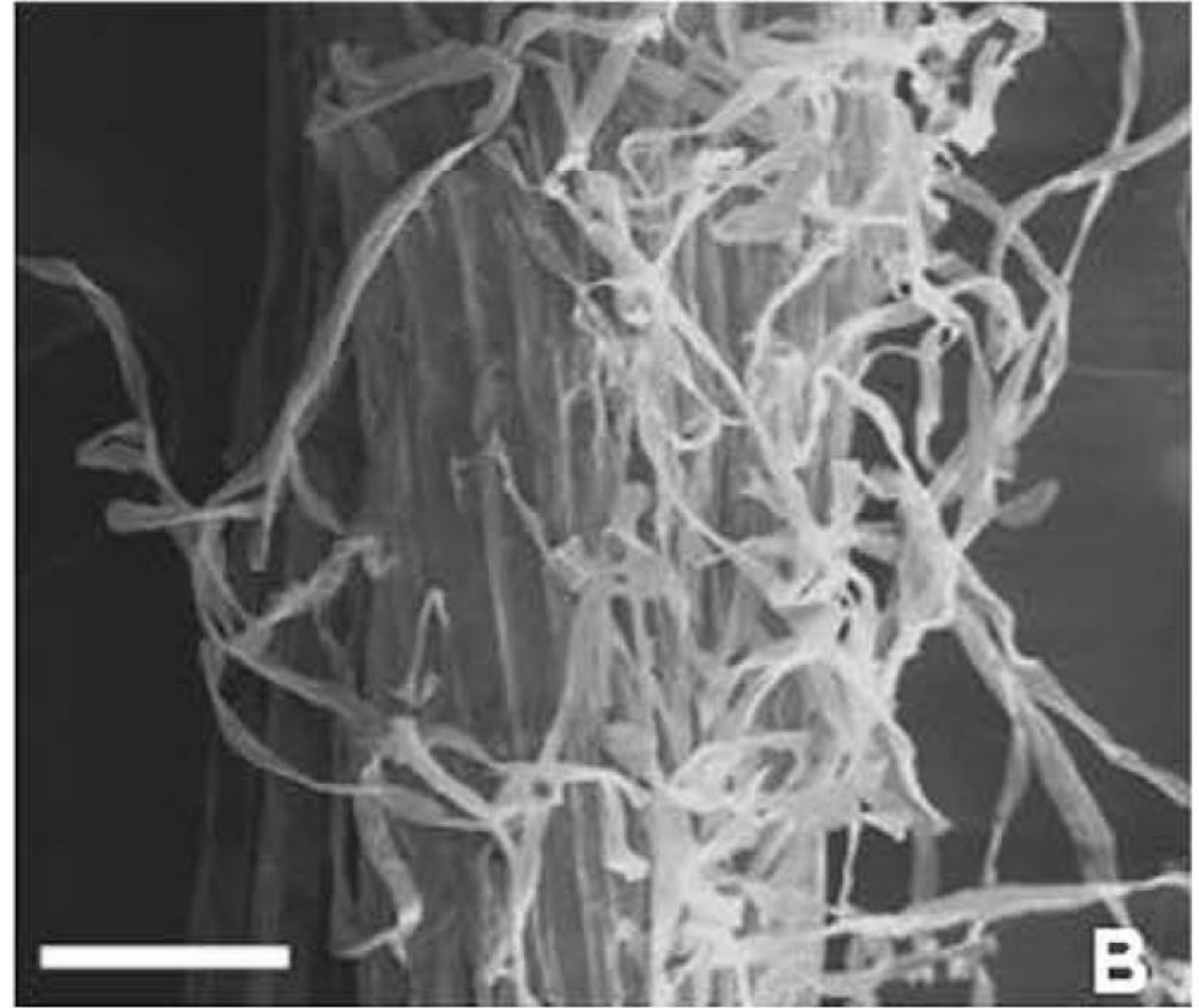
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Root Hair Stimulation



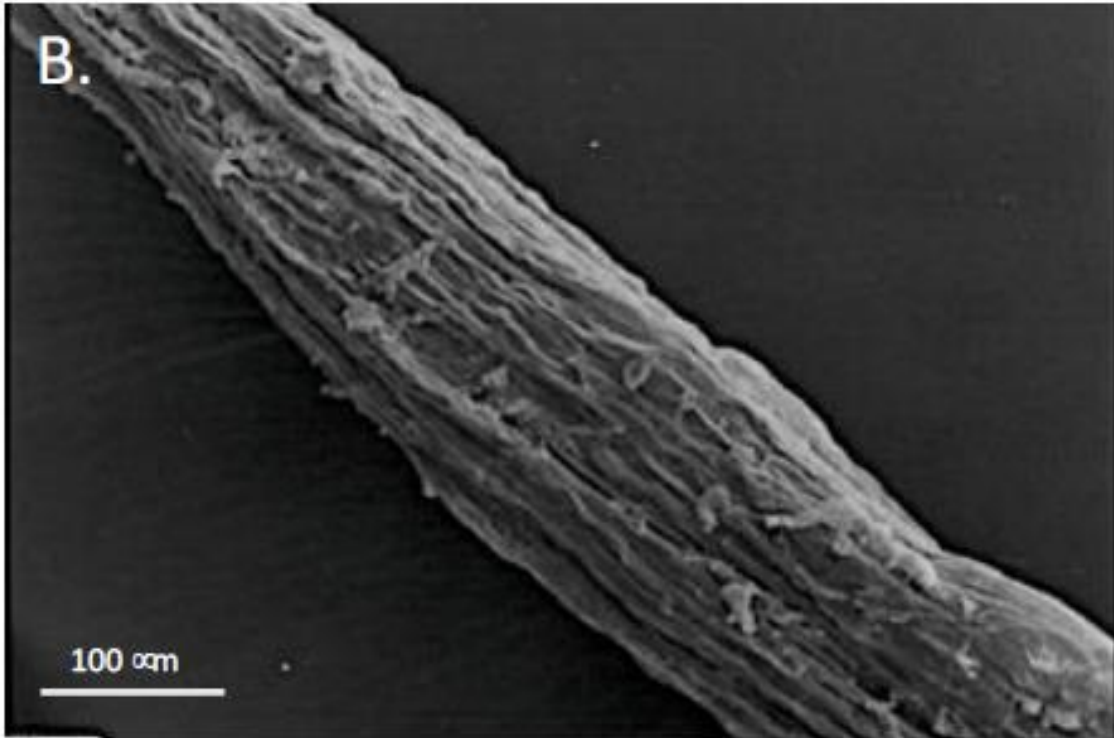
A = w/o Humic Acid



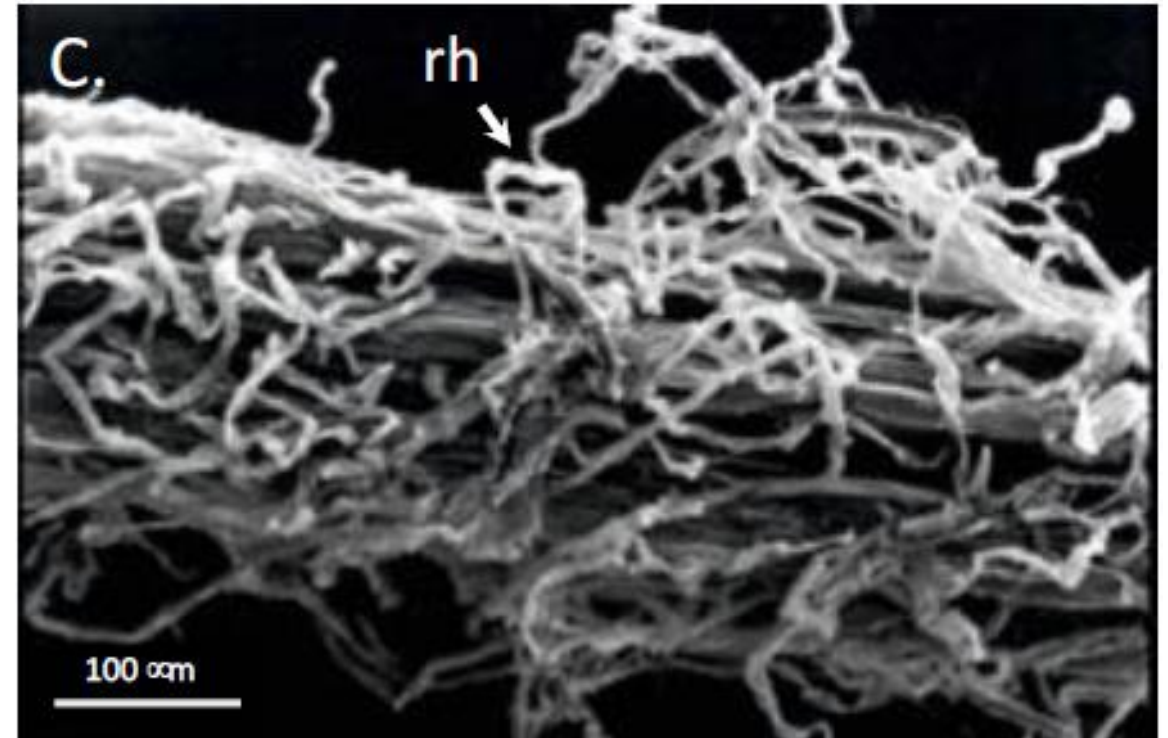
B = w/ Humic Acid



Root Hair Stimulation



A = w/o Humic Acid



B = w/ Humic Acid

Root Stimulation

- Cucumber plants
- Germination phase = 7 days
- Growth phase = 10 days
- Humic acid added on day 17
- Picture - 72 hours later
- 44% greater root mass

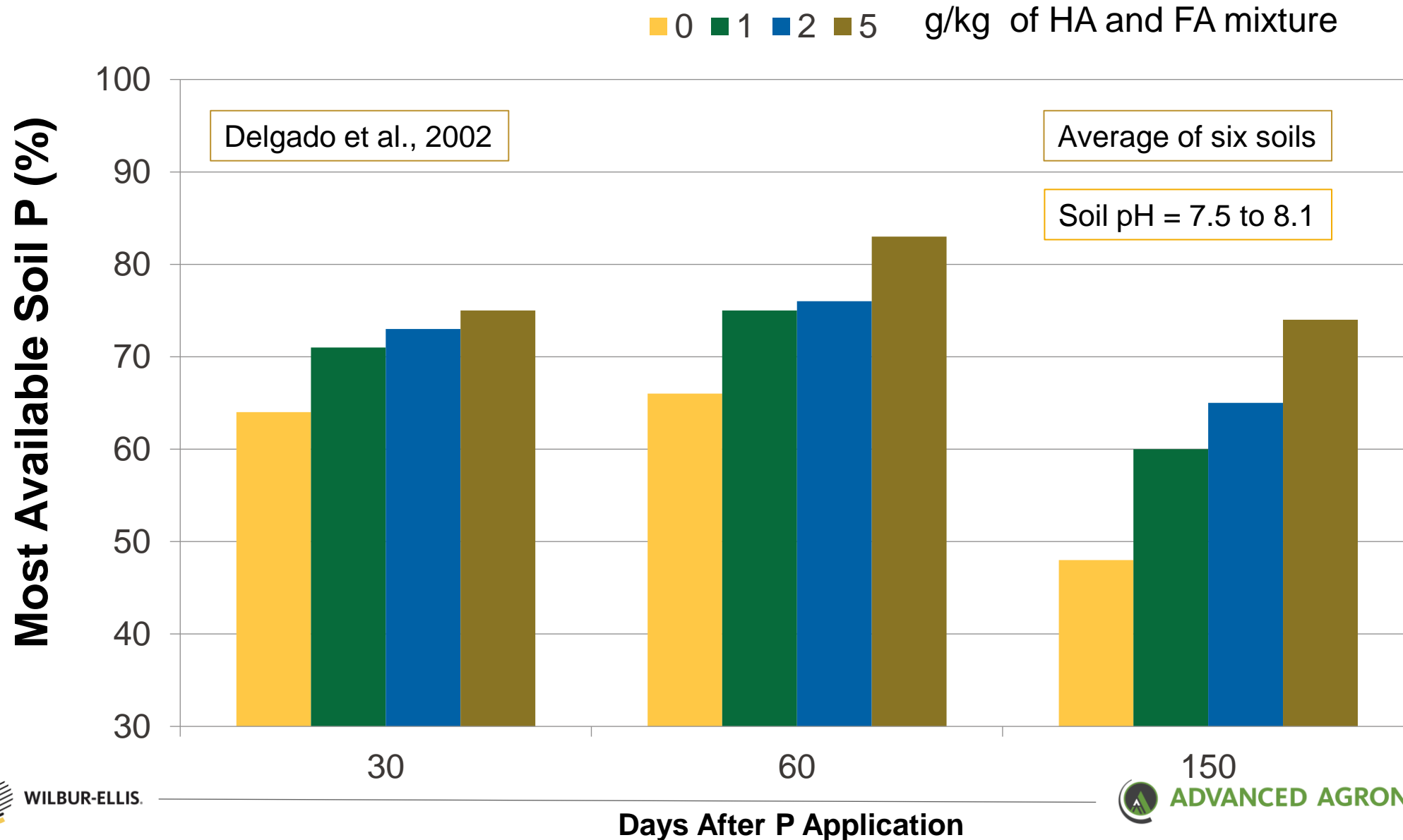
Control →



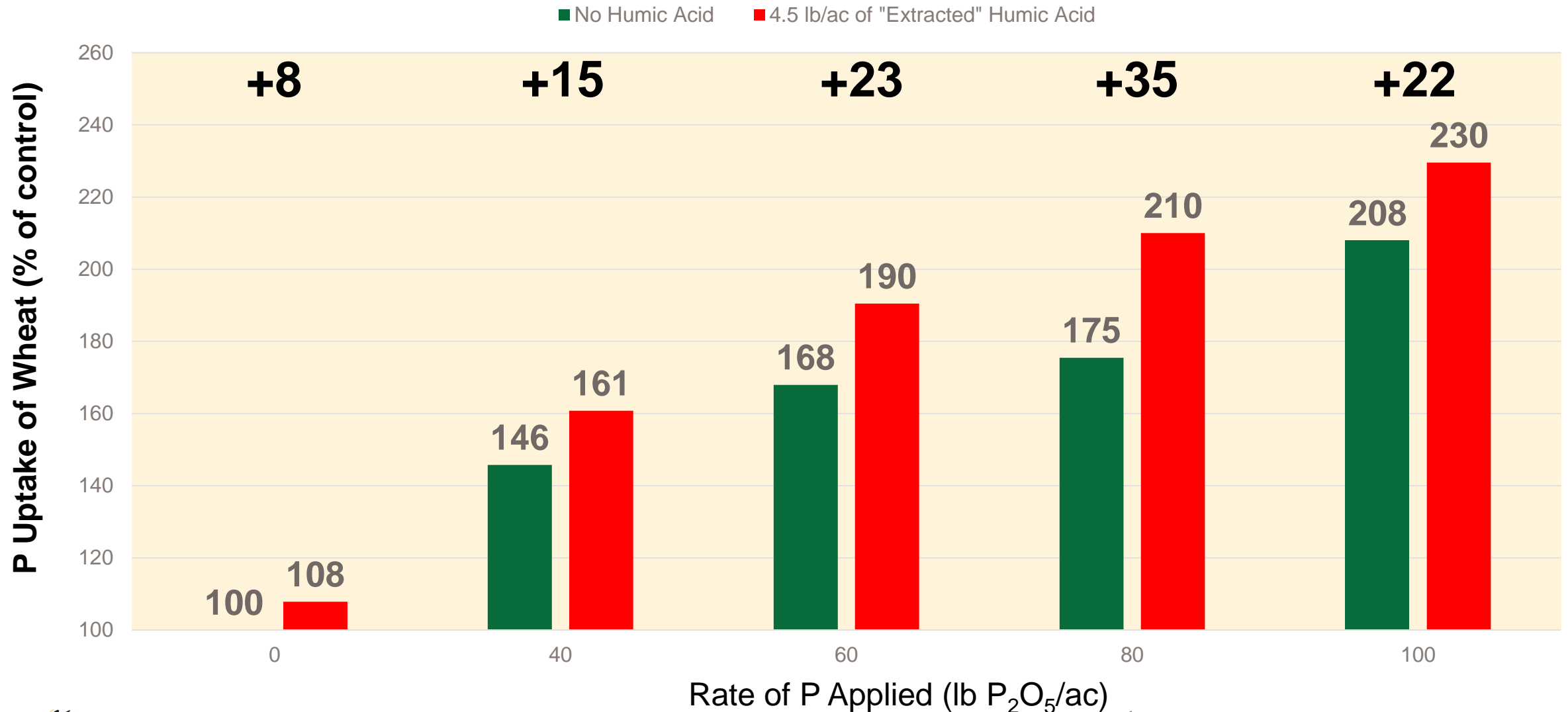
← Humic Acid



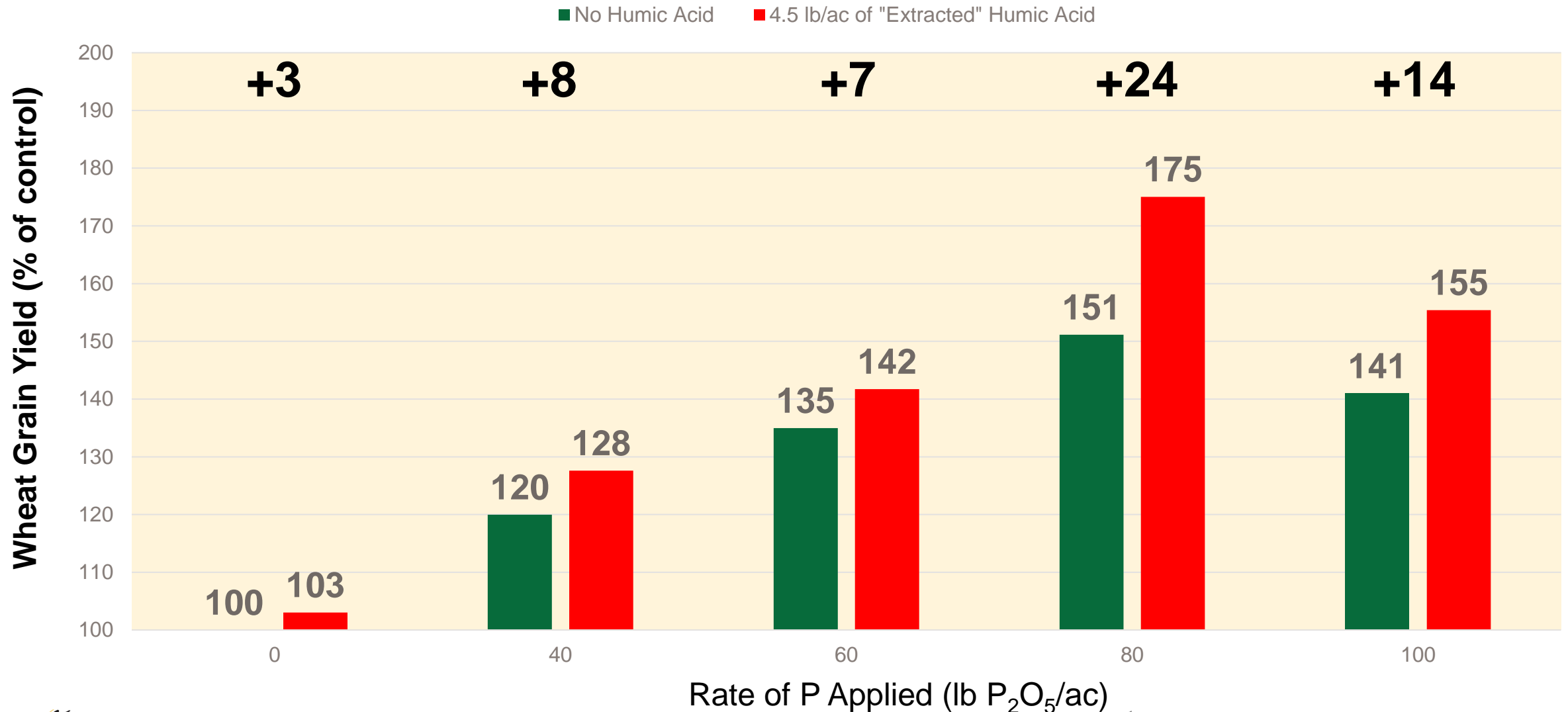
Effect on P Fertilizer Availability



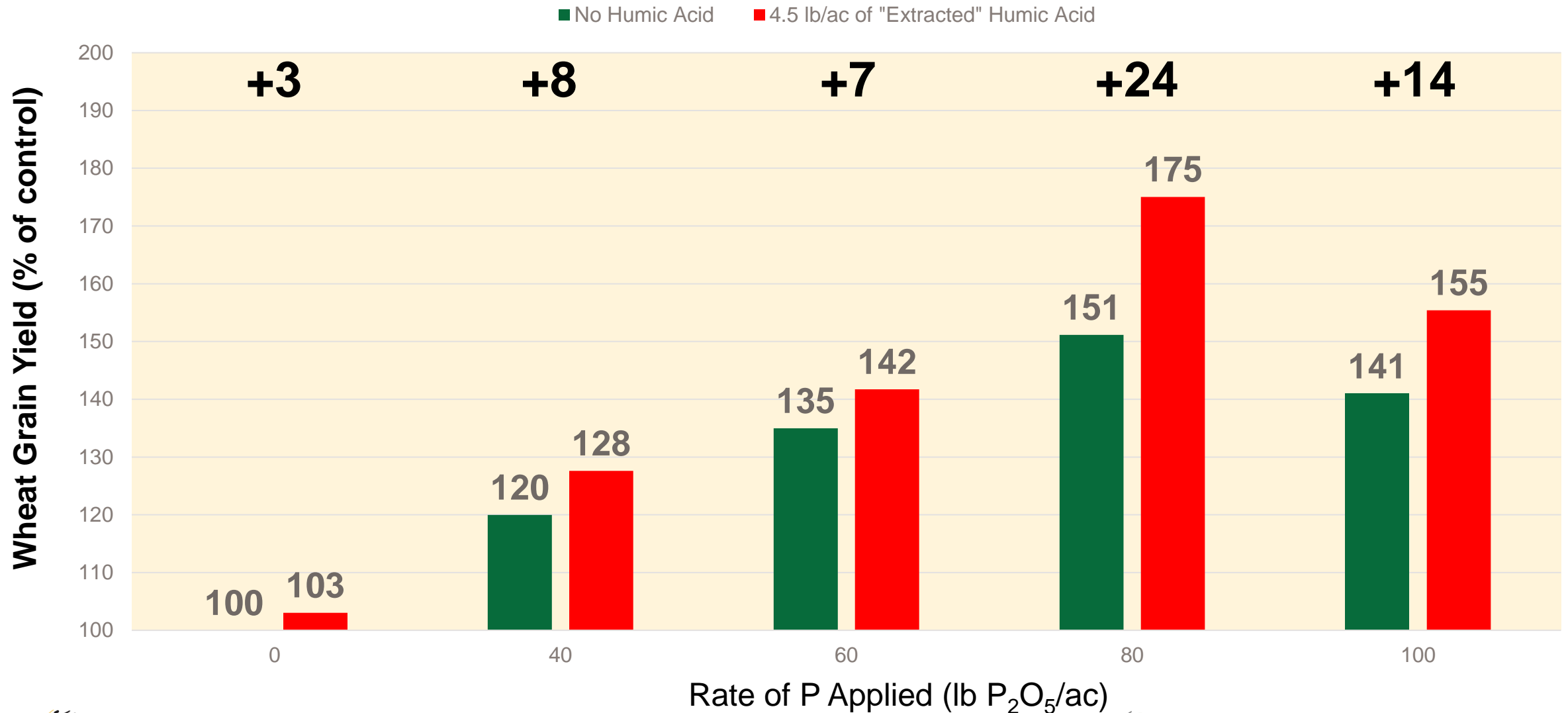
P Fertilizer & Humic Acid on Wheat



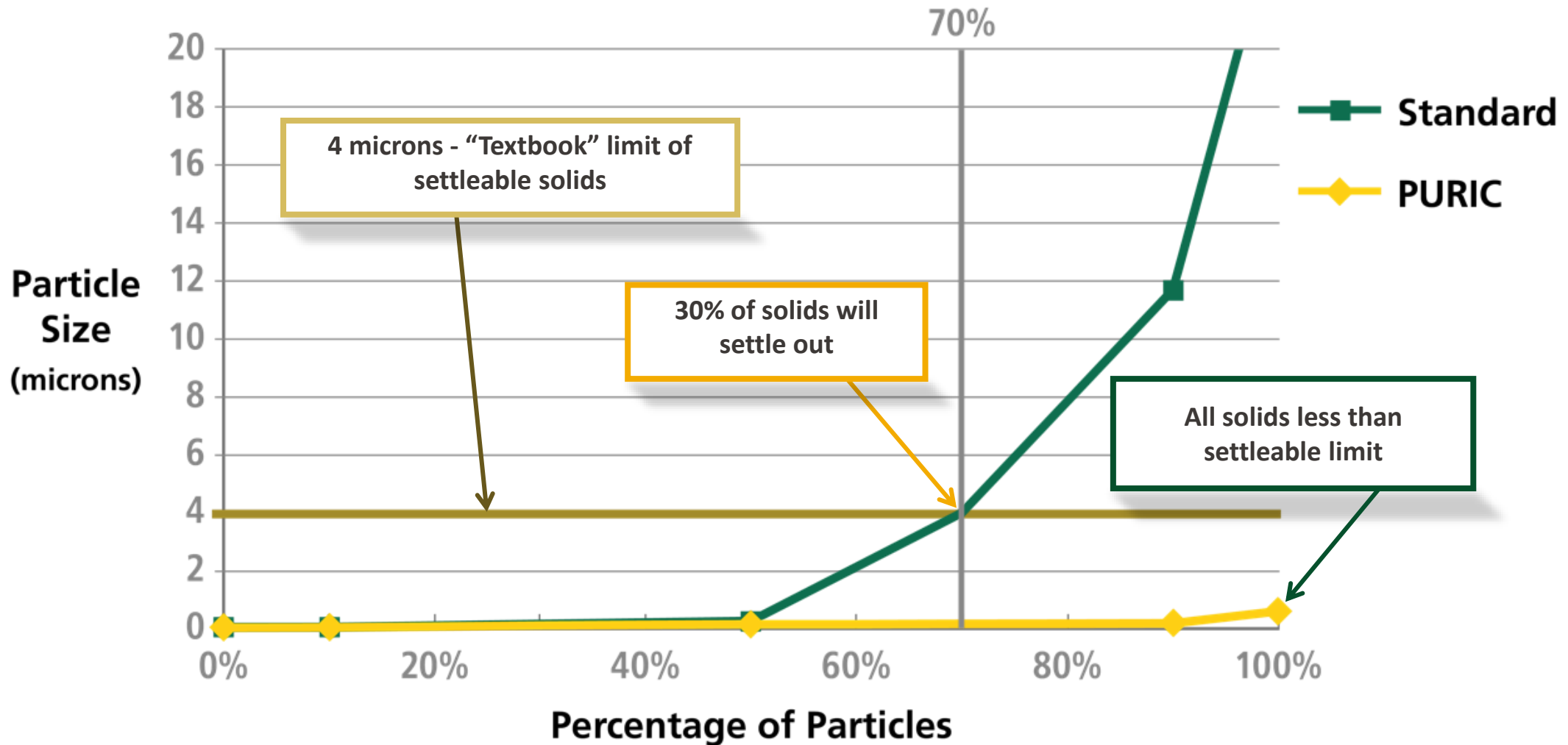
P Fertilizer & Humic Acid on Wheat



P Fertilizer & Humic Acid on Wheat



PURIC Particle Size





GUARANTEED ANALYSIS

Total Nitrogen (N) 1.00%
1.00% Ammoniacal Nitrogen
Soluble Potash (K_2O) 2.00%

DERIVED FROM: Ammonium Hydroxide and Potassium Hydroxide.

ALSO CONTAINS NON-PLANT FOOD INGREDIENT:

12.00% Humic Acids derived from Leonardite.

- Liquid product with pH of about 9
- CDFA = 12% H.A. (Colorimetric = 24%)
- Starter/UAN additive or standalone
- Improved compatibility with fertilizer
- Not compatibility w/ Ca-based products
- Not for use in Organic Agriculture?



GUARANTEED ANALYSIS

Soluble Potash (K_2O) 3.00%

DERIVED FROM: Potassium Hydroxide.

ALSO CONTAINS NON-PLANT FOOD INGREDIENT:
8.00% Humic Acids derived from Leonardite.

- Liquid product
- 8% Humic Acid
- Unique product

- Unmatched fertilizer compatibility
- Mixes with all fertilizers
- Even acidic and calcium-based
- pH = 5



CONTAINS NON-PLANT FOOD INGREDIENT:

3.00% ACTIVE INGREDIENT:
.....Fulvic Acid

97.00% INACTIVE INGREDIENTS:
..... (Carboxylic Acid and Water)

100.00%

- pH = 2.5
 - Liquid product
 - 3% fulvic acid
 - OMRI & WSDA
-
- Use when H.A. black color is an issue
 - Good choice for foliar additive
 - Excellent fertilizer compatibility

Puric WSG

- Dry product
- 0–0–12
- Unique – how?
- High Humic Acid content
- “Extracted” Humic Acid



PURIC WSG

Extraction is KEY

PURIC WSG

Extracted Humic Acid

Water soluble granules



LEONARDITE

No extraction

Not water soluble



Durum Wheat
Picture taken on
50 lb 11-52-0

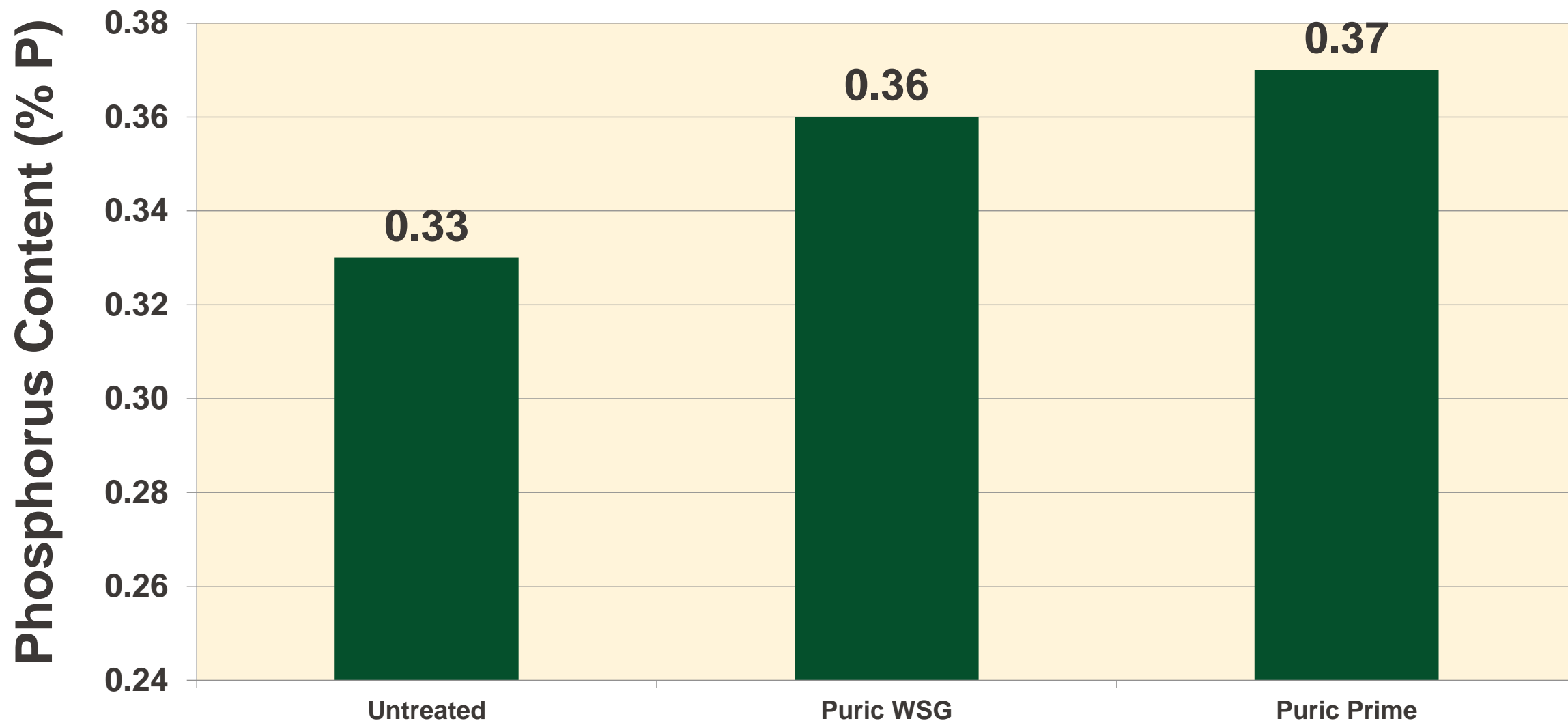
Field but includes
PURIC WSG



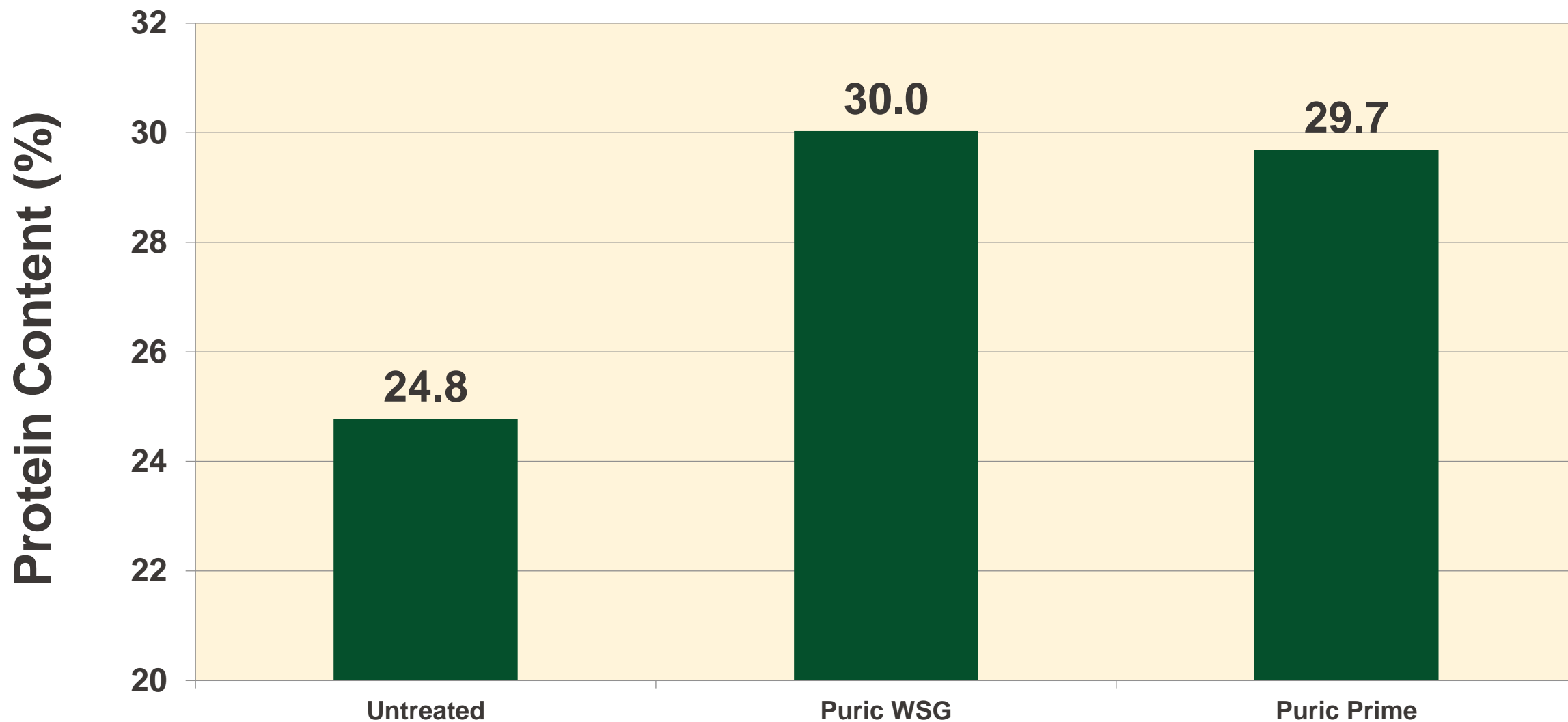
Christmas Valley Nutrient-Use Efficiency Project



Humic Acid on Alfalfa



Humic Acid on Alfalfa

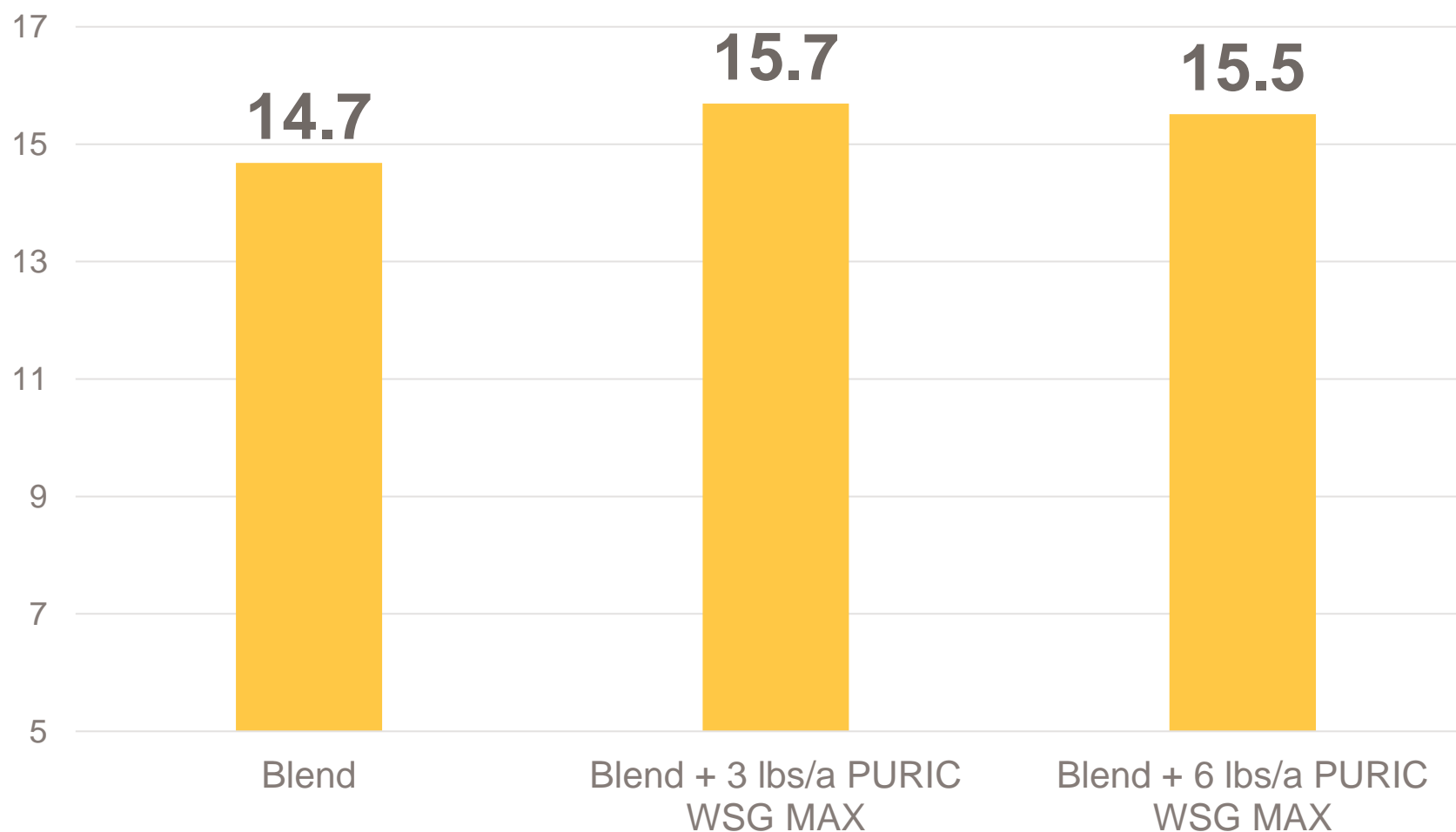


Texas Projects with Puric WSG



PURIC WSG in Triticale and Corn Silage

Triticale yield (tons/ac)



BPS226008TX03



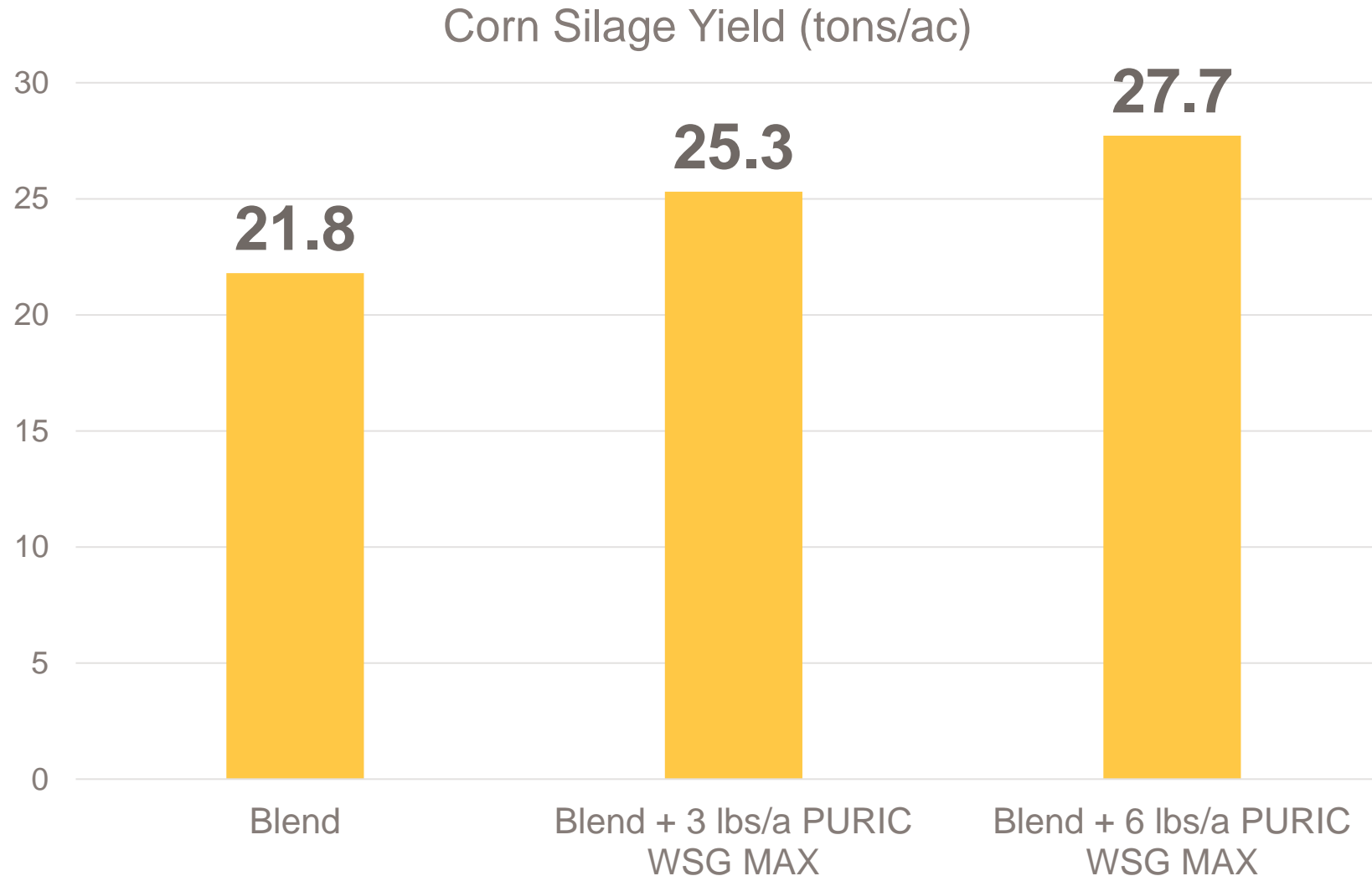
WILBUR-ELLIS.

Fertilizer/WSG applied on October 12, 2021 -- Planted on October 19 -- Harvested on May 12



ADVANCED AGRONOMY ACADEMY®

PURIC WSG in Triticale and Corn Silage



BPS226008TX03



WILBUR-ELLIS

Fertilizer/WSG applied on October 12, 2021 -- Planted on October 19 -- Harvested on May 12



ADVANCED AGRONOMY ACADEMY®

Humic/Salt section



Evaluation of PURIC WSG on Alfalfa Yield

Objectives

- Evaluate the impact of PURIC WSG MAX on alfalfa yield.

Methods

- PURIC WSG MAX was spread on half of the field in February at a rate of 10 lbs/a.
- Alfalfa was cut four times
 - June 12th
 - July 13th
 - August 15th
 - September 28th
- At each cutting 12 subsamples were taken from each half of the field for yield.

Trial Details			
Crop(s), Variety	Alfalfa	Year Established	2022
Location	Estancia, NM	Discipline	Plant Health
Target/Pest	Yield	Manager	Dustin Kelley
Team	SHL	Investigator	Dustin Kelley
Other		Trial Number	SHL227004NM01

SHL227004NM01



Evaluation of PURIC WSG on Alfalfa Yield

Soil sample analysis from the first and fourth cuttings

Timing	Treatment	Soil pH	% Organic Matter	Sol. Salts (mmho/cm)	Nitrate-Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)	Sulfur (ppm)	Sodium (ppm)	Calcium (ppm)
1st Cutting	Untreated	8.0	1.7	3.65	1.9	45	255	2060	850	17400
4th Cutting	Untreated	8.0	1.9	2.84	2.5	39	203	2800	527	21200
1st Cutting	10 lbs/a PURIC WSG MAX	8.0	1.4	3.59	1.2	41	244	3210	833	15500
4th Cutting	10 lbs/a PURIC WSG MAX	8.1	1.7	2.11	2.1	43	214	4600	450	17000

Timing	Treatment	Magnesium (ppm)	Zinc (ppm)	Iron (ppm)	Manganese (ppm)	Copper (ppm)	CEC	% K	% Ca	% Mg	% Na
1st Cutting	Untreated	1230	1.0	9	26	1.1	40	2	63	26	9
4th Cutting	Untreated	1070	1.3	9	20	1.2	37	1	68	24	6
1st Cutting	10 lbs/a PURIC WSG MAX	1140	0.9	11	34	1.2	39	2	65	25	9
4th Cutting	10 lbs/a PURIC WSG MAX	931	1.0	13	42	1.4	35	2	71	22	6

Willard Loam Soil

SHL227004NM01

Evaluation of PURIC WSG on Alfalfa Yield

Plant tissue analysis from the fourth cutting

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Calcium (%)	Magnesium (%)	Sulfur (%)
Untreated	3.64	0.25	2.42	1.70	0.75	0.59
10 lbs/a PURIC WSG MAX	3.97	0.26	2.46	1.91	0.74	0.63

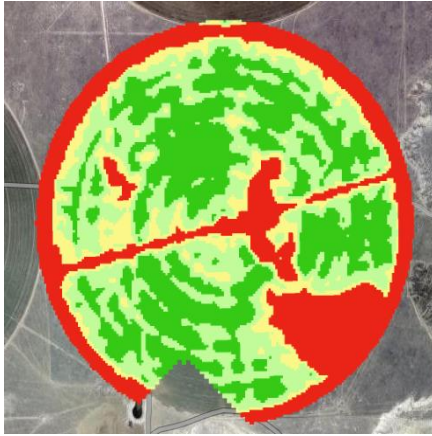
Treatment	Zinc (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Copper (mg/kg)	Boron (mg/kg)	Sodium (%)
Untreated	23	97	40	8	63	0.846
10 lbs/a PURIC WSG MAX	26	113	55	9	75	0.598

SHL227004NM01



Evaluation of PURIC WSG on Alfalfa Yield

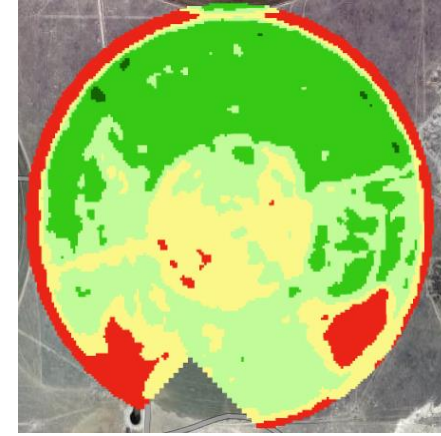
May 26th, 2022



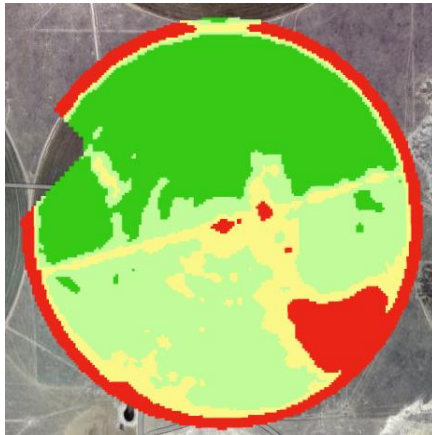
July 7th, 2022



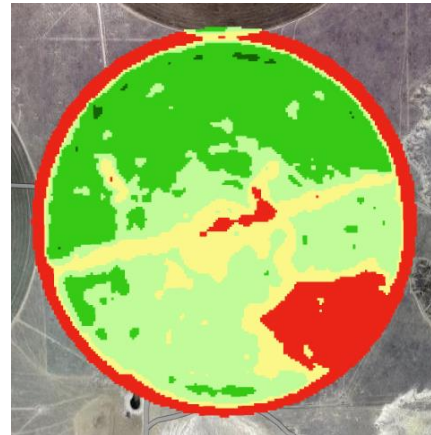
July 27th, 2022



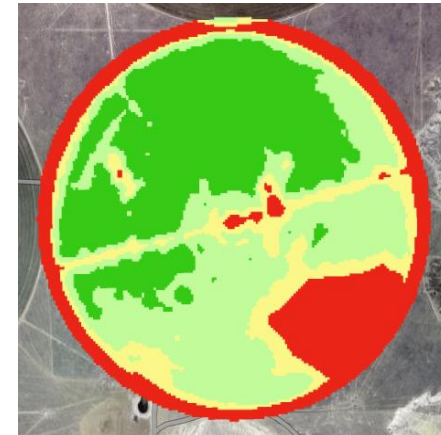
August 4th, 2022



August 29th, 2022



September 8th, 2022



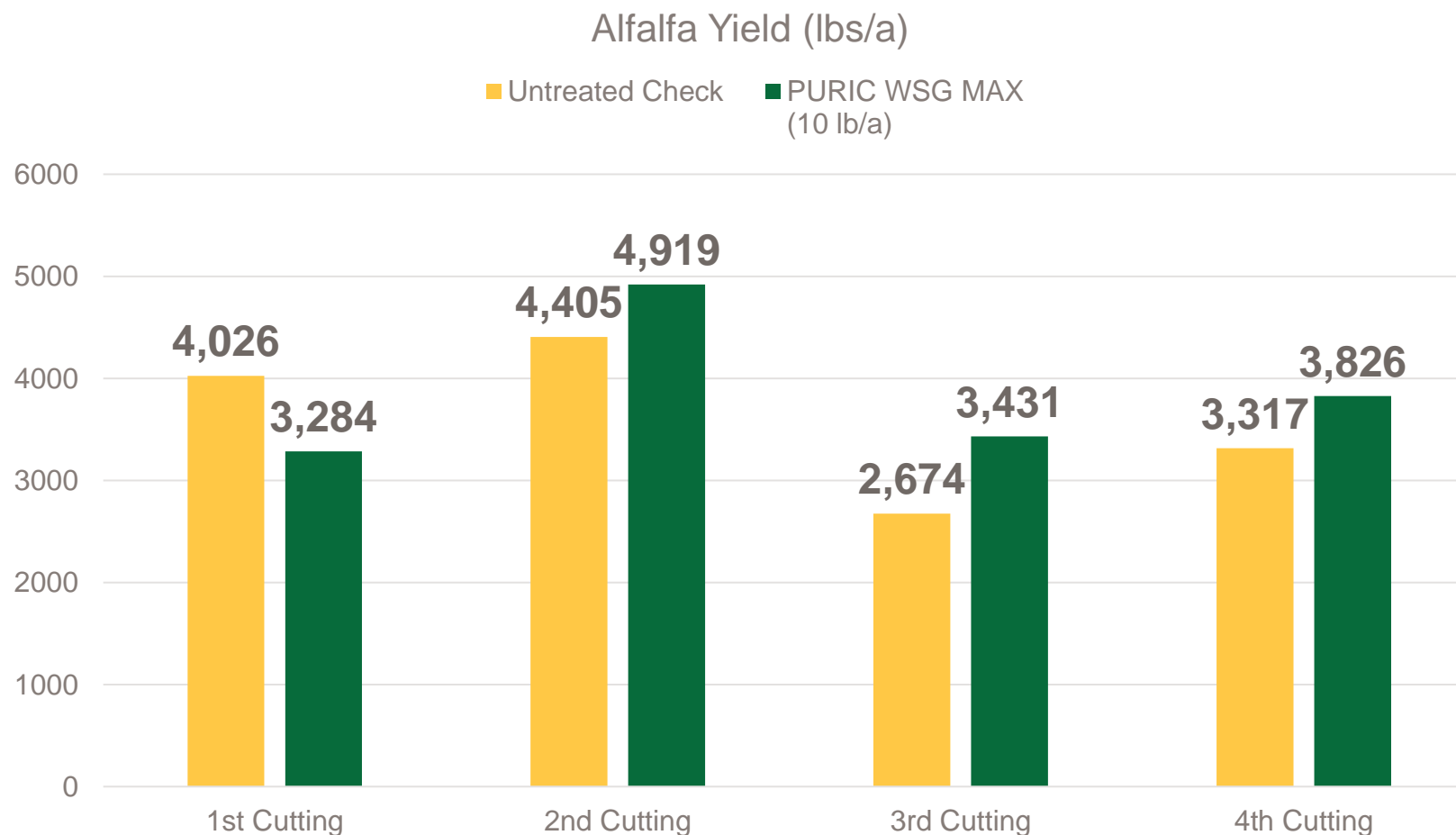
Imagery from
Climate
Fieldview.

Darker green
equals a
higher
biomass
percentage

The north half
(top in image)
of the field
received 10
lbs/a PURIC
WSG MAX

SHL227004NM01

Evaluation of PURIC WSG on Alfalfa



Cumulative total

- Untreated 7.2 tons
- Treated 7.7 tons

SHL227004NM01

Impact P Availability in Soils?

Rate of P applied

Band Application

Nutrio Unlock

Humic & Fulvic Acids (PURIC)

Nutrio + Puric in combination

Key Facts of Nutrio Unlock

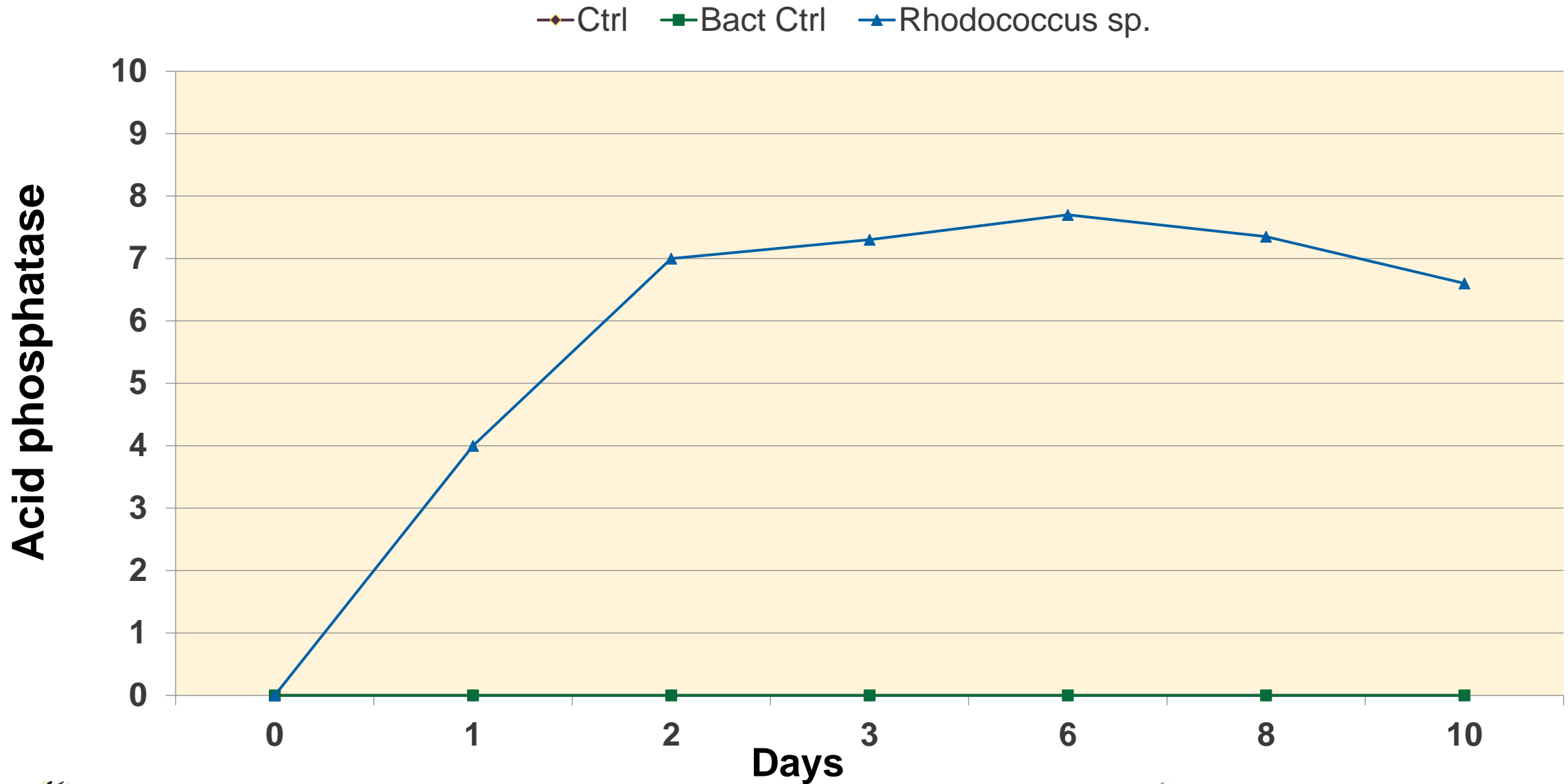
- Consortium of 7 beneficial microbes
- Isolated from highly productive soils
- Isolated from the rhizosphere
- Strong producers of enzymes & organic acids
- 100% pure strains – consistent responses
- Improve nutrient availability (N, P, & micros)

Beneficial Bacteria Strain	Functions
<i>Rhodobacter palustris</i>	<ul style="list-style-type: none">• Produces favorable enzymes for nitrogen fixation• Improves organic matter mineralization• Strong enzyme producer – amylase and protease
<i>Bacillus brevis</i>	<ul style="list-style-type: none">• Enhances phosphorus availability• Boosts plant biomass• Strong extracellular enzyme producer – wide spectrum
<i>Bacillus licheniformis</i>	<ul style="list-style-type: none">• Increases plant root establishment and development• Aides in organic mineralization
<i>Streptomyces griseus</i>	<ul style="list-style-type: none">• Enhances nutrient uptake
<i>Bacillus megaterium</i>	<ul style="list-style-type: none">• Enhances nutrient release• Improves nitrogen fixation• Boosts phosphate solubilization
<i>Rhodococcus rhodochrous</i>	<ul style="list-style-type: none">• Enhances nitrogen fixation• Converts nitrogen into a usable plant form• Improves organic matter mineralization• Superior enzyme secretor – amylase, protease, lipase
<i>Lactobacillus plantarum</i>	<ul style="list-style-type: none">• Enhances nitrogen fixation• Nutritionally adaptive• Utilizes alternate forms of organic carbohydrates• Increases phosphorus utilization

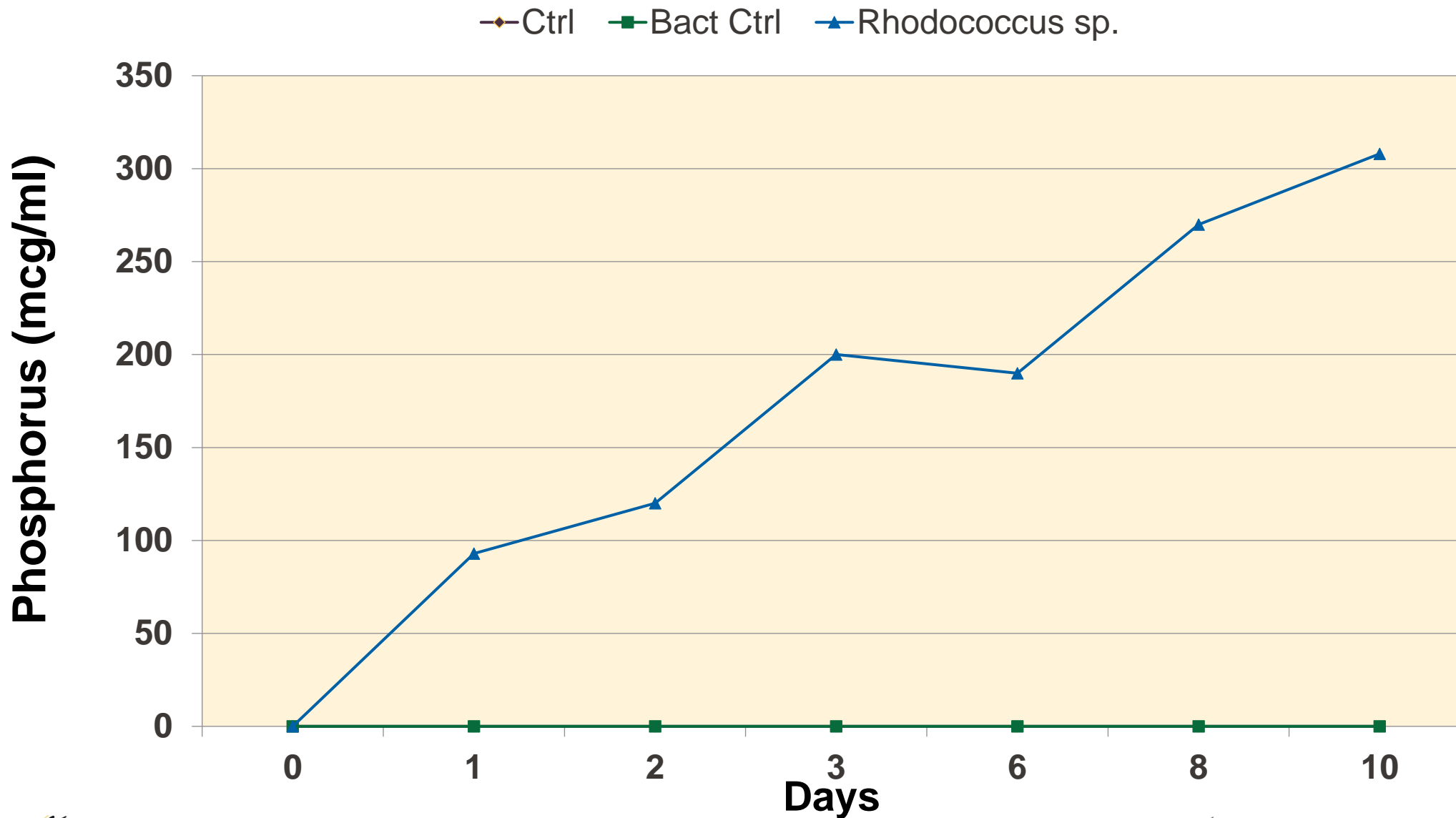
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Phosphatase Enzyme



Phosphorus Solubilized



Nutrio Unlock Experience

- Launched product in 2016 (new product award)
- Great success in Midwest
- Success followed in other crops
- Product responses have been numerous
- Nutrio Unlock just keeps Winning!
- Enhanced by applying with Puric Products!



CONTAINS NON-PLANT FOOD INGREDIENTS:

Contains 60 million colony forming units (CFU) per gallon of the following:

<i>Rhodopseudomonas palustris</i>	2.26 x 10 ³ CFU/ml
<i>Bacillus brevis</i>	2.26 x 10 ³ CFU/ml
<i>Bacillus licheniformis</i>	2.26 x 10 ³ CFU/ml
<i>Streptomyces griseus</i>	2.26 x 10 ³ CFU/ml
<i>Bacillus megaterium</i>	2.26 x 10 ³ CFU/ml
<i>Rhodococcus rhodochrous</i>	2.26 x 10 ³ CFU/ml
<i>Lactobacillus plantarum</i>	2.26 x 10 ³ CFU/ml



Nutrio Unlock on Wheat



**Nutrio Unlock
@ 8 fl oz/ac**



Untreated

Nutrio Unlock on Almond Trees



**Nutrio Unlock
@ 1 qt/ac**



Untreated



WILBUR-ELLIS.

W-E Western Crop Research



ADVANCED AGRONOMY ACADEMY®

Nutrio Unlock on Wine Grapes



**Nutrio Unlock
@ 1 qt/ac**



Untreated



WILBUR-ELLIS.

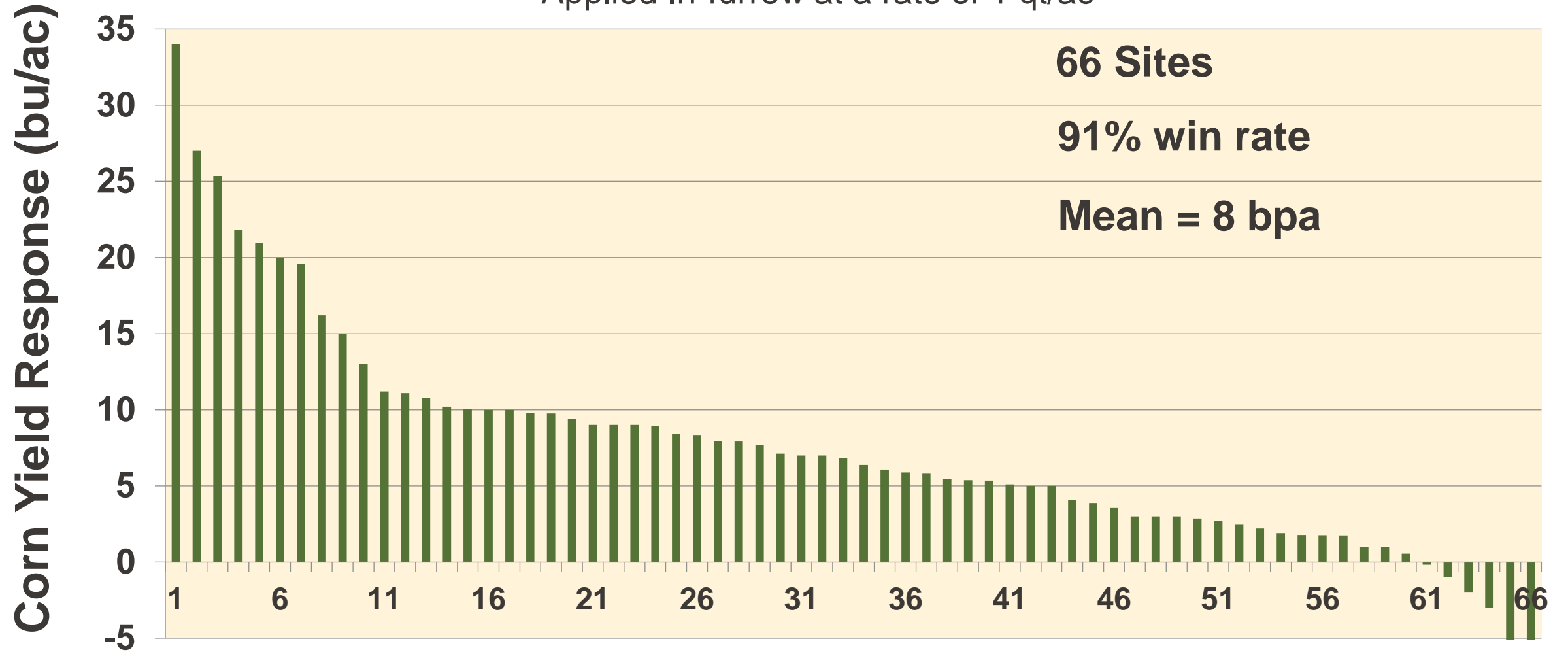
W-E Western Crop Research



ADVANCED AGRONOMY ACADEMY®

Nutrio Unlock at Planting

Applied In-furrow at a rate of 1 qt/ac



Impact P Availability in Soils?

Rate of P applied

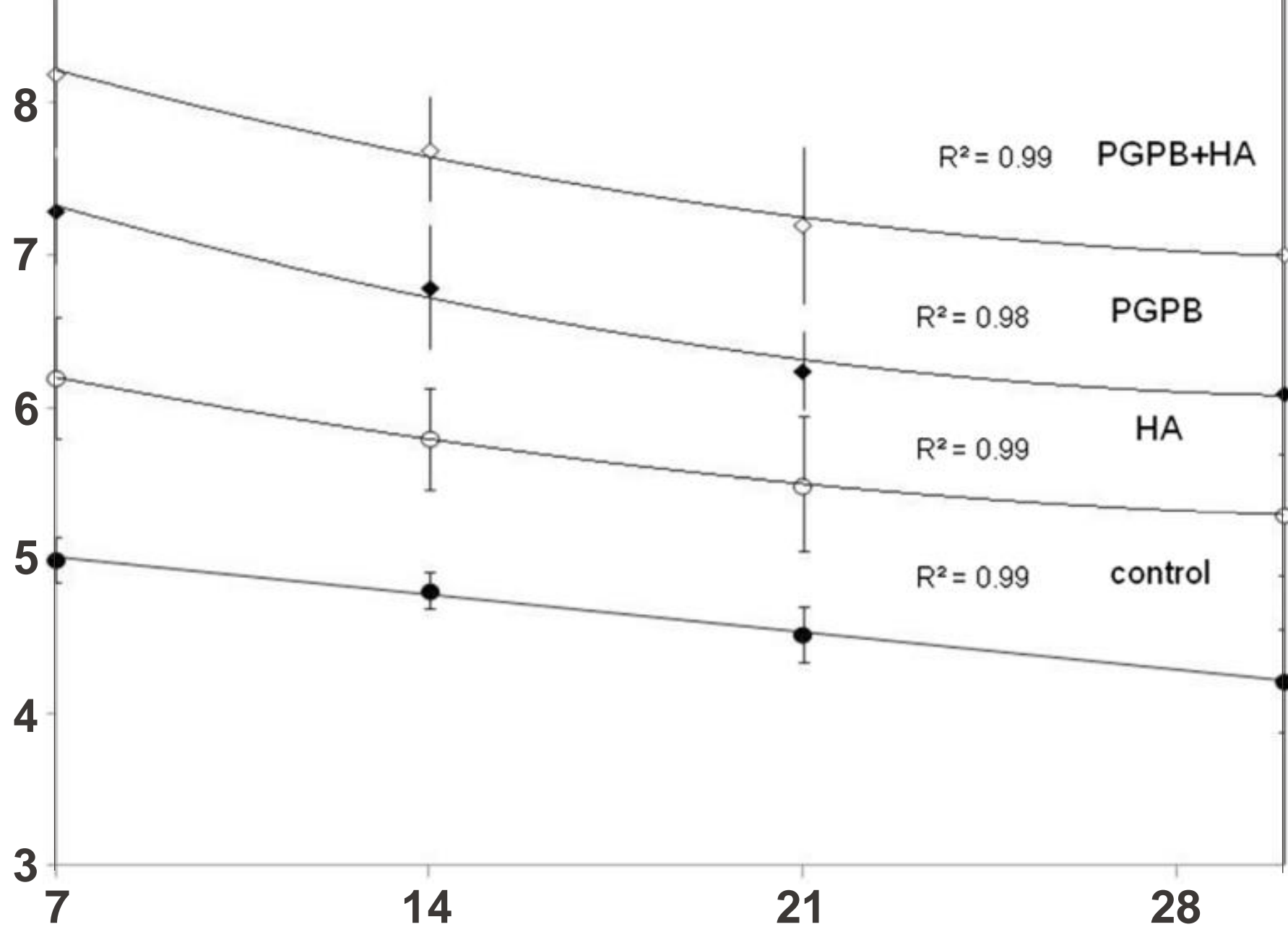
Band Application

Nutrio Unlock

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Nutrio + Puric in combination

Number of Bacterial Cells on Corn Roots
(log cells per gram of fresh root tissue)



Days after Inoculation with PGPR



WILBUR-ELLIS.

Lima et al., 2014 (Canellas Lab)



ADVANCED AGRONOMY ACADEMY®

Black Hills Spruce Trees



Untreated



Nutrio + Puric

Fraser Fir Trees



Untreated



Nutrio + Puric



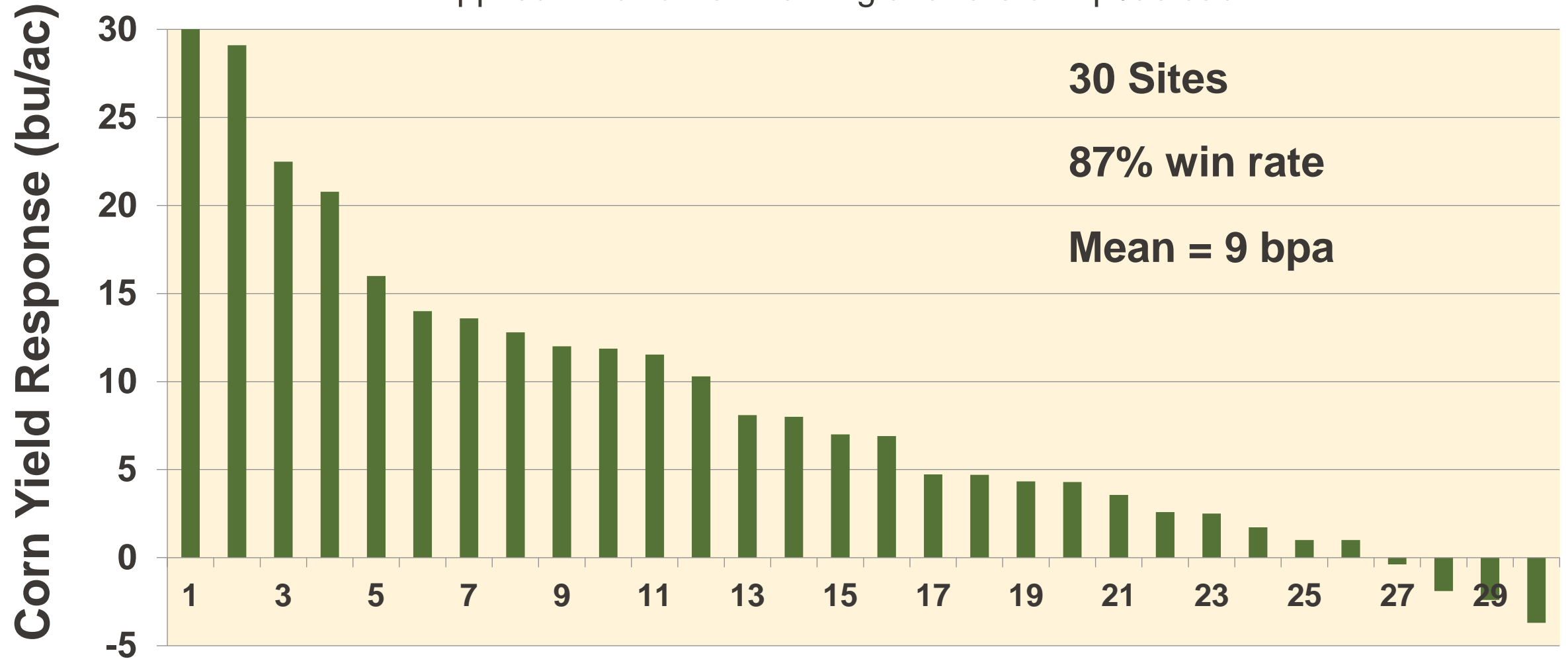
Most Impressive finding...

**Production time went
from 19 month to
10 months**



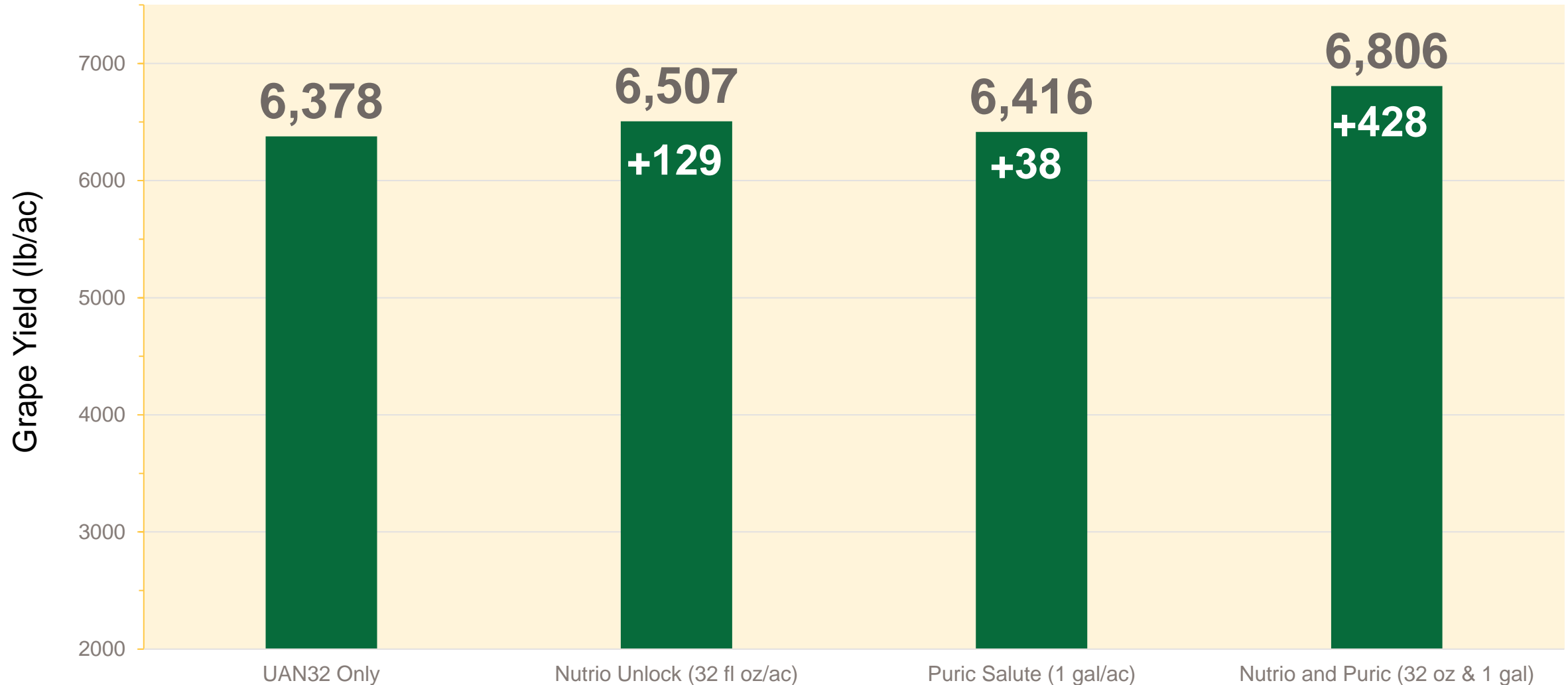
Nutrio Unlock & Puric Prime

Applied In-furrow at Planting at a rate of 1 pt/ac each



Nutrio & Puric - Pinot Noir Grapes

All four treatments received UAN32 at a rate of 10 lb N/acre per application



Rate Applied for Each of the Two Applications



WILBUR-ELLIS.

Treatments injected during spring bloom & fall bunch closure

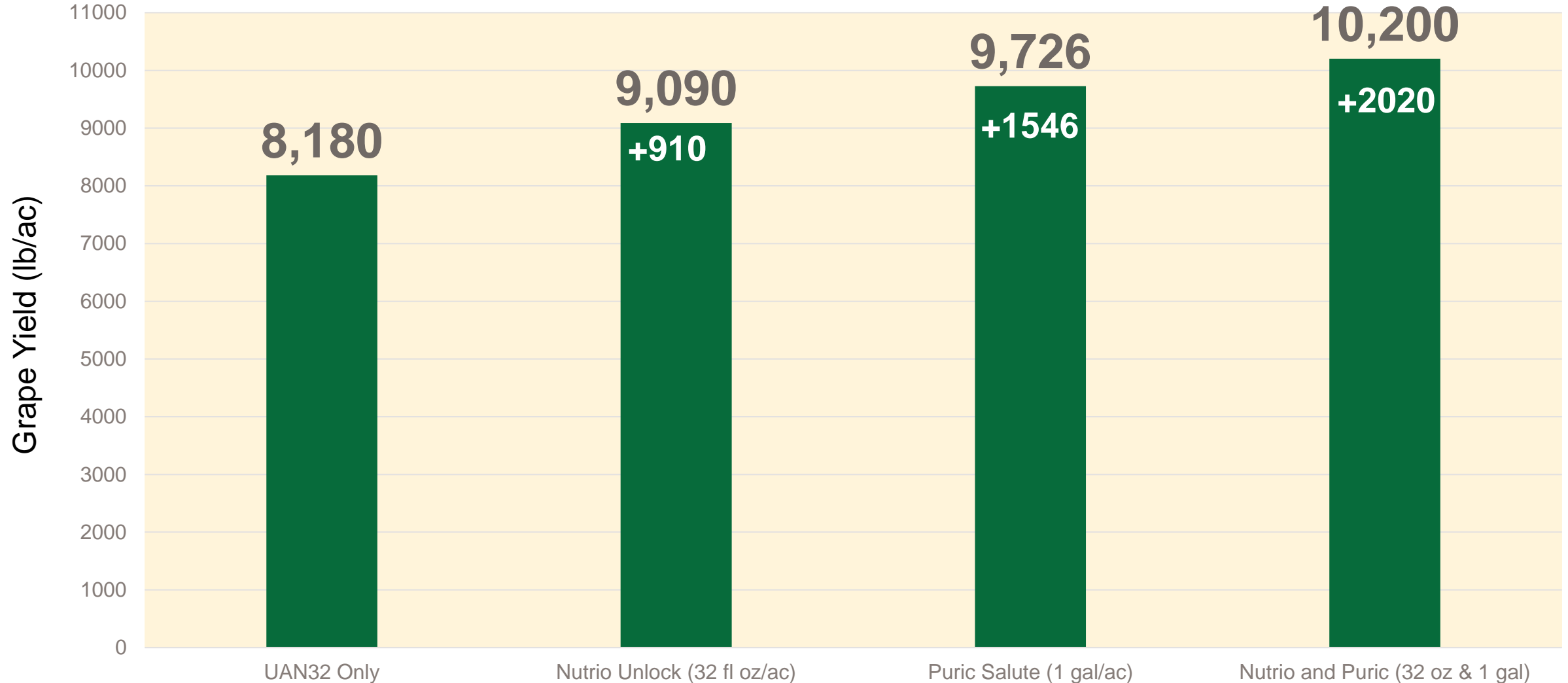
Research conducted by Cascadia Ag



ADVANCED AGRONOMY ACADEMY®

Nutrio & Puric - Pinot Noir Grapes

All four treatments received UAN32 at a rate of 10 lb N/acre per application



Rate Applied for Each of the Two Applications



WILBUR-ELLIS.

Treatments injected during spring bloom & fall bunch closure

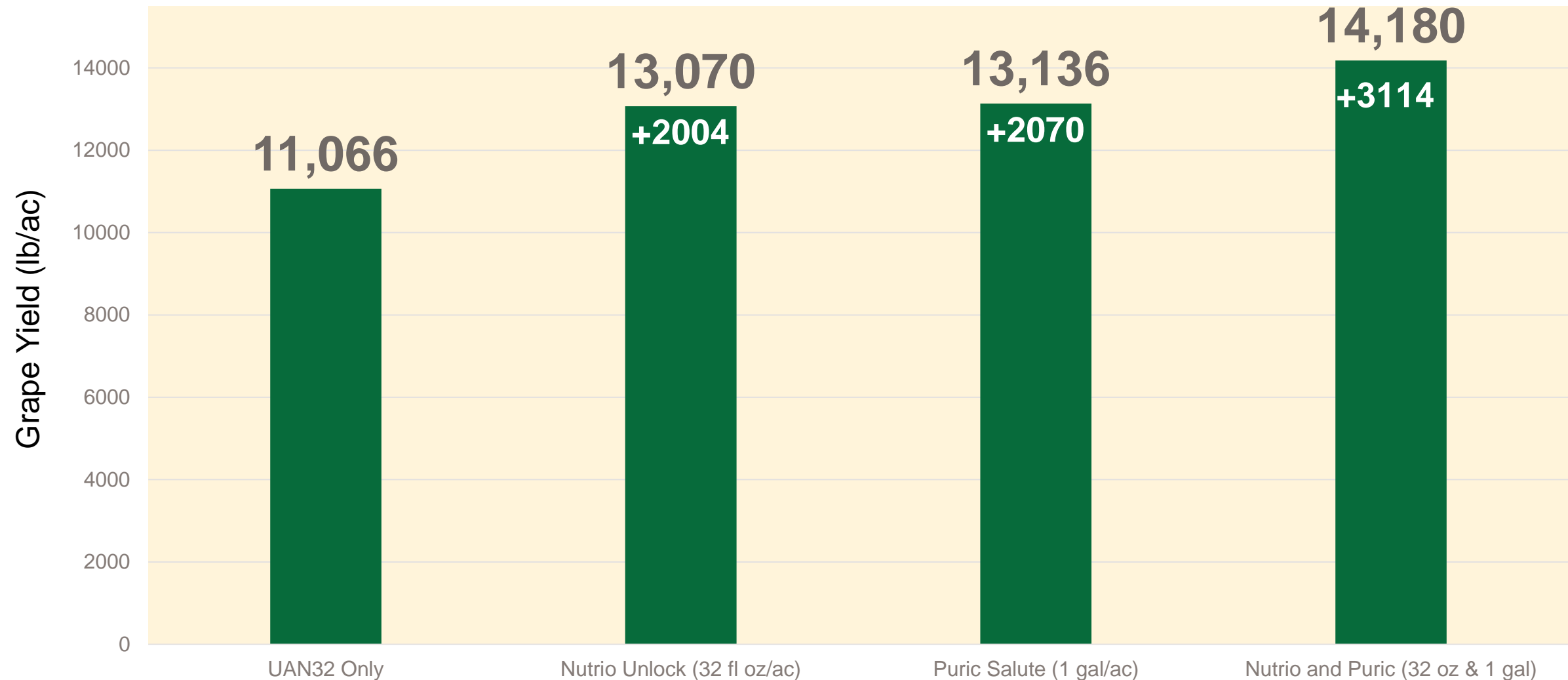
Research conducted by Cascadia Ag



ADVANCED AGRONOMY ACADEMY®

Nutrio & Puric - Pinot Noir Grapes

All four treatments received UAN32 at a rate of 25 lb N/acre per application





ALSO CONTAINS NON-PLANT FOOD INGREDIENTS:

1.40% Humic Acid derived from Leonardite.

Contains 60 million colony forming units (CFU) per gallon of the following:

<i>Rhodopseudomonas palustris</i>	2.26 x 10 ³ CFU/ml
<i>Bacillus brevis</i>	2.26 x 10 ³ CFU/ml
<i>Bacillus licheniformis</i>	2.26 x 10 ³ CFU/ml
<i>Streptomyces griseus</i>	2.26 x 10 ³ CFU/ml
<i>Bacillus megaterium</i>	2.26 x 10 ³ CFU/ml
<i>Rhodococcus rhodochrous</i>	2.26 x 10 ³ CFU/ml
<i>Lactobacillus plantarum</i>	2.26 x 10 ³ CFU/ml

GUARANTEED ANALYSIS

Total Nitrogen (N)5.00%

5.00% Ammoniacal Nitrogen

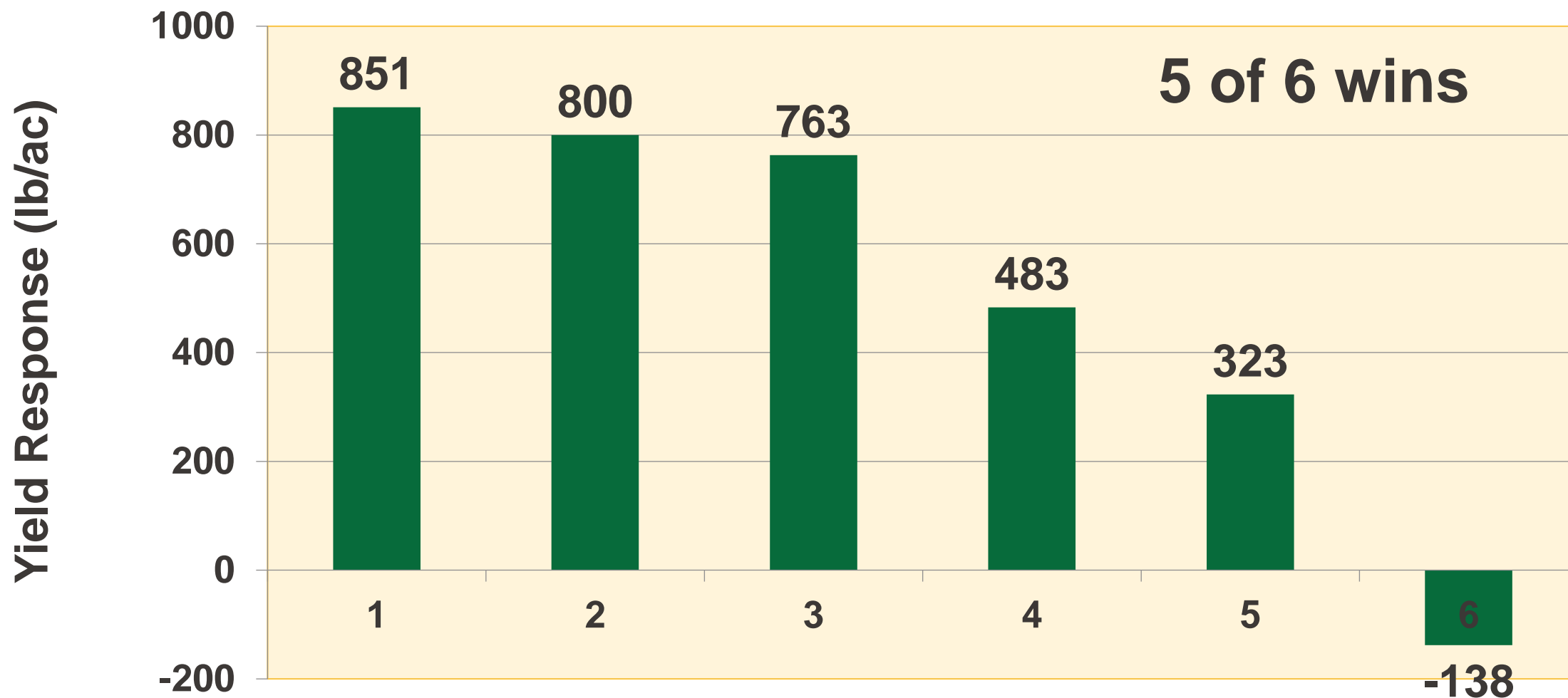
Sulfur (S)5.00%

DERIVED FROM: Ammonium Sulfate.

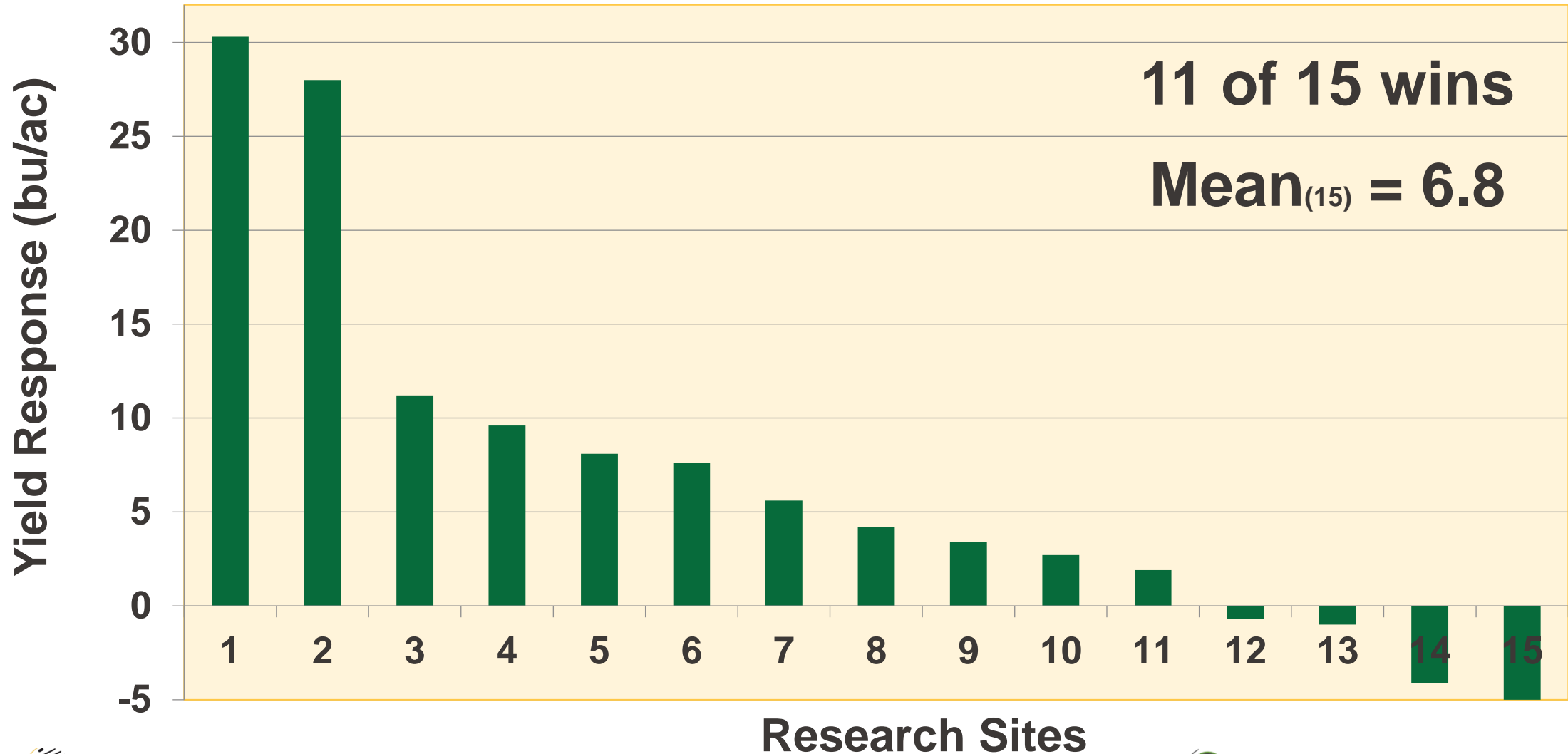
Recommended Rate = 0.5 to 2 quarts/ton



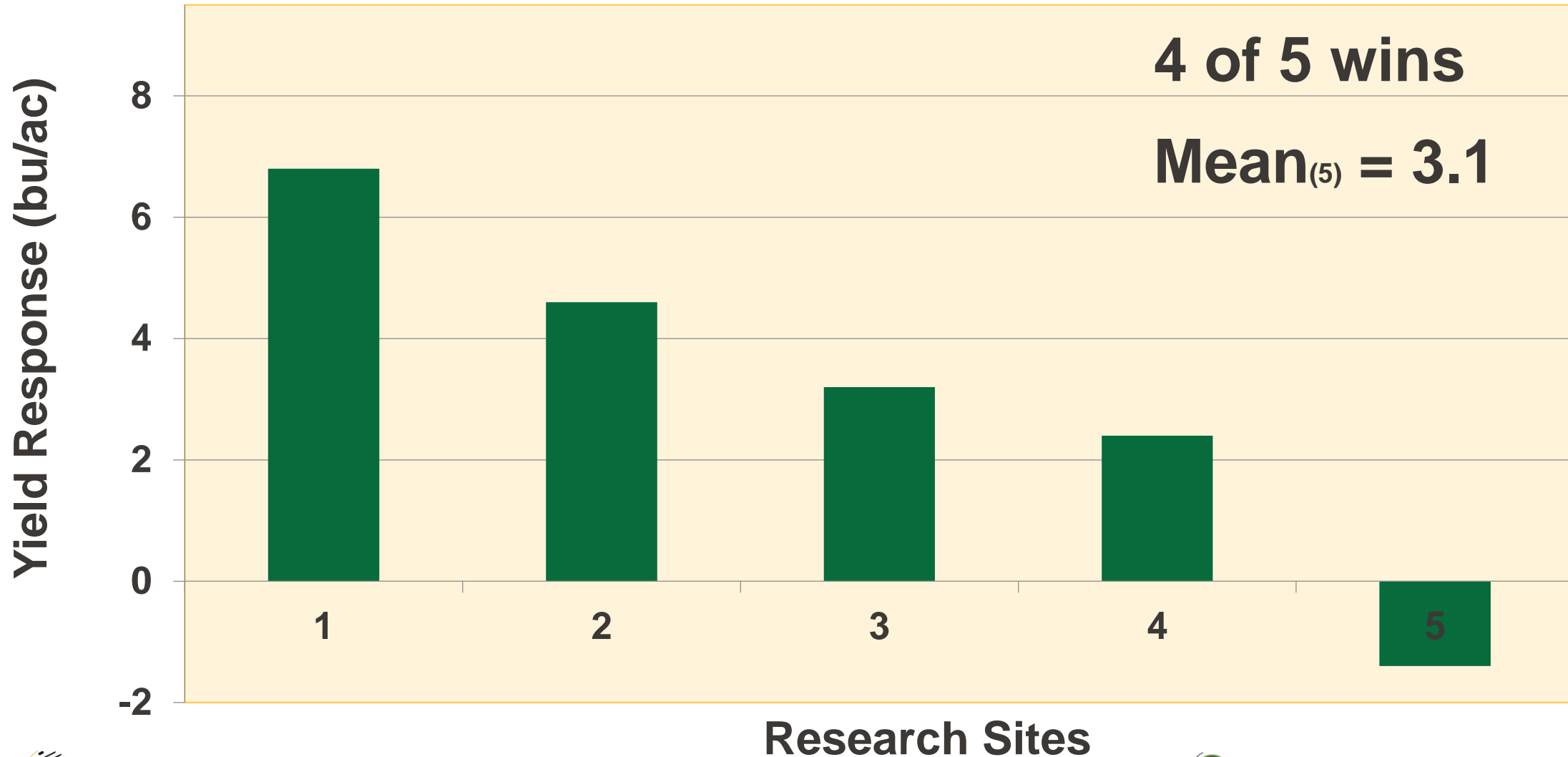
Nutrio High Gear II – Alfalfa Summary



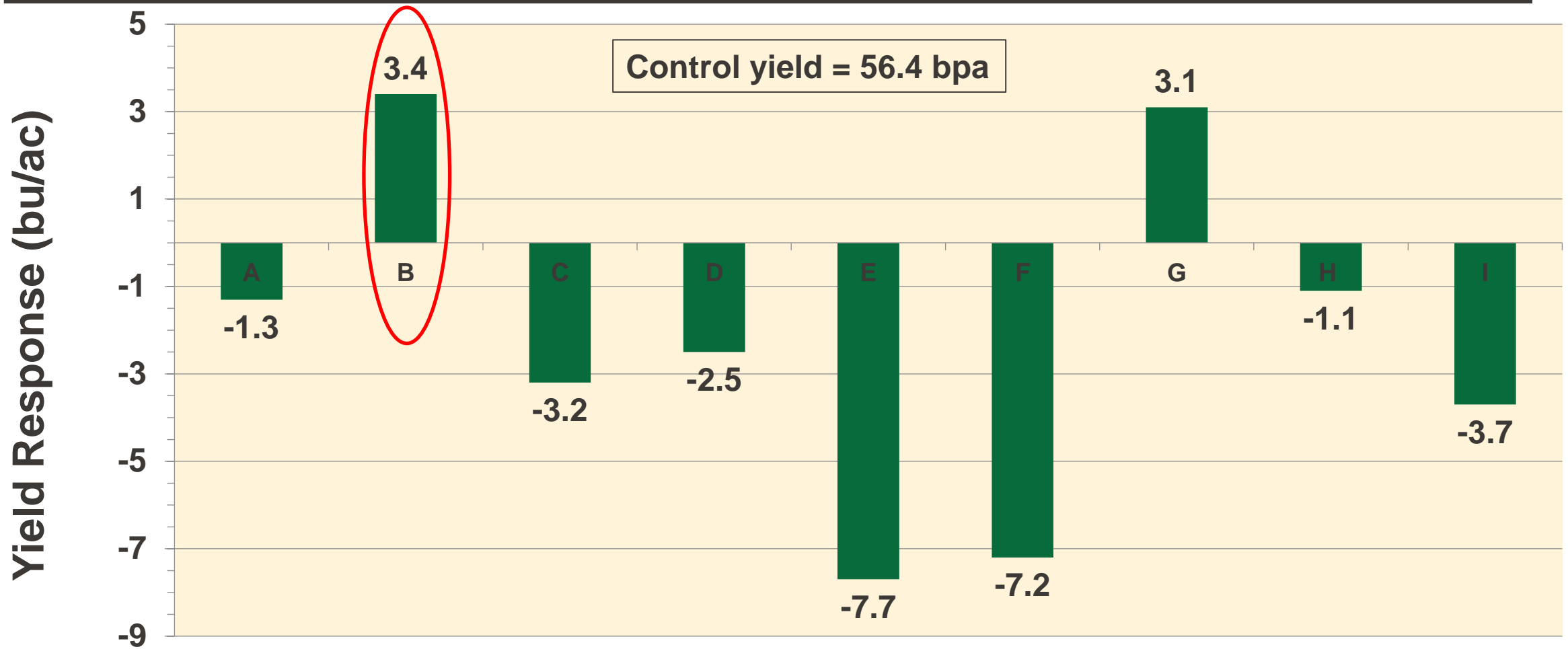
Nutrio High Gear II – Corn Summary



Nutrio High Gear II – Wheat Summary

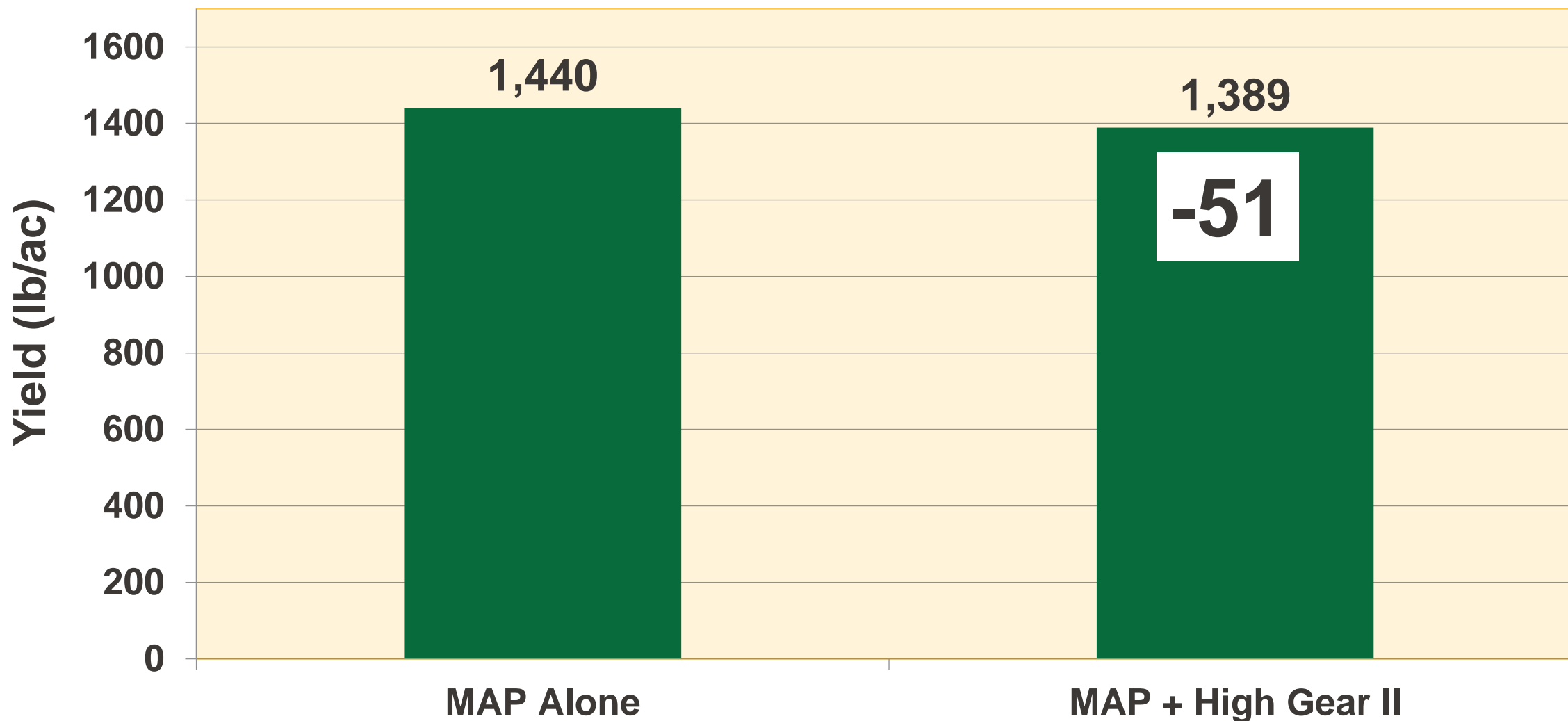


Montana State University

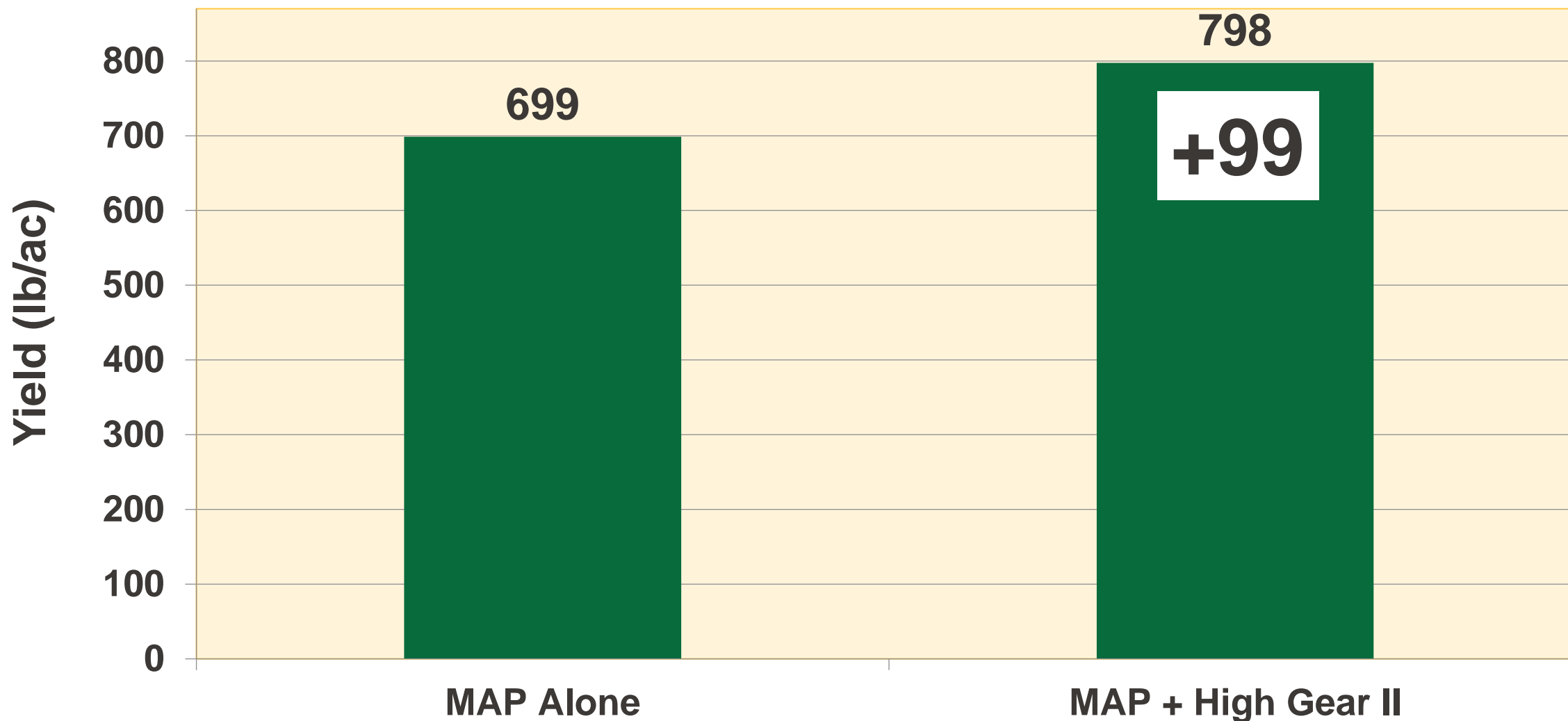


9 Biological Products applied to Spring Wheat as recommended by product label

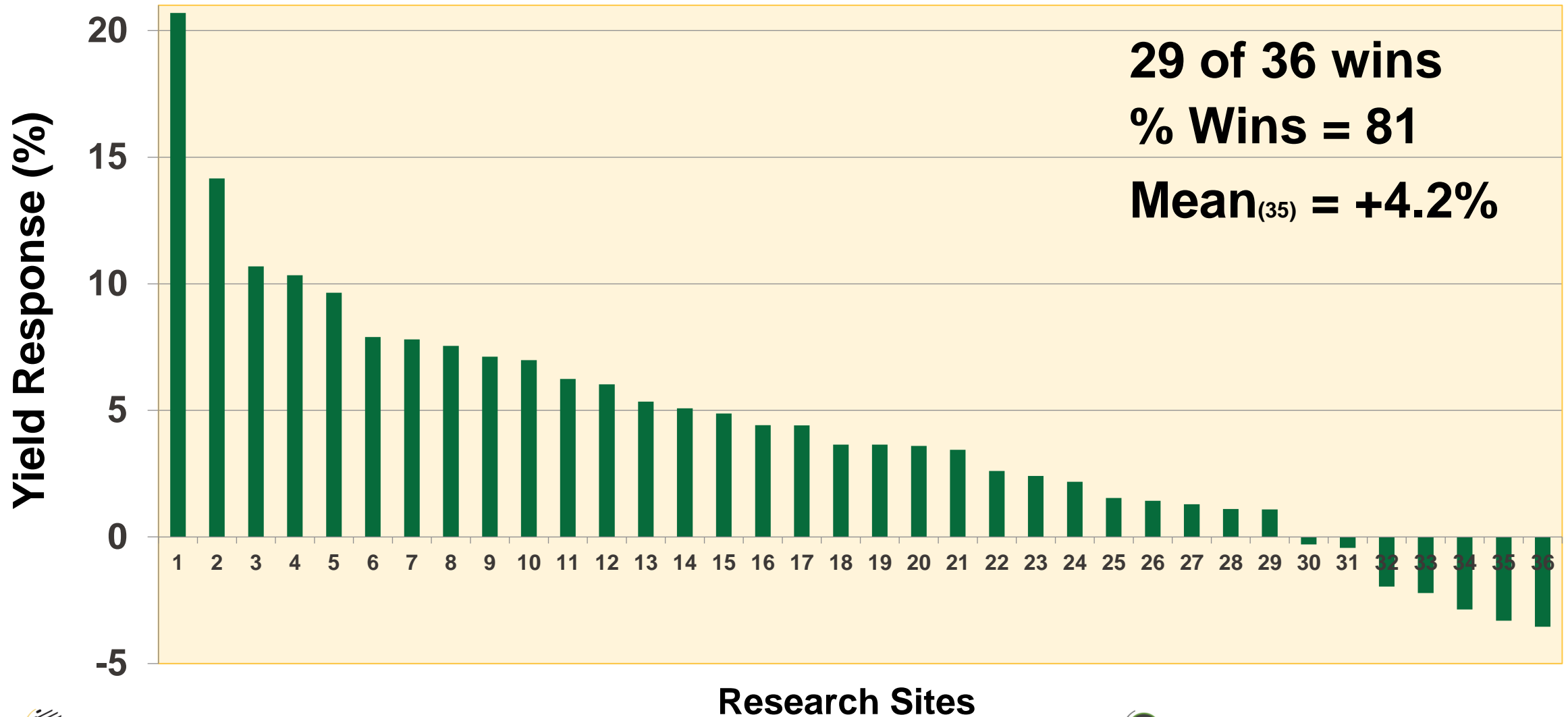
Nutrio High Gear II on Canola



Nutrio High Gear II on Chickpea



Nutrio High Gear II – ALL CROPS



High Gear II Experience in west Texas



Questions

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