

# Plant Growth Regulation Products – Potential for Increasing Low Desert Production Values



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# PALO VERDE VALLEY



# PARKER VALLEY, ARIZONA



# Imperial Valley, California



# Wide diversity of crops in the low desert!



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With this wide variety of crops,  
what's the probability that  
plant growth regulation products  
can not increase  
crop production values  
of at least one (or more) crops?



# Plant Growth Regulation Use Areas

- HARVEST AID
- GROWTH REDUCTION
- GROWTH/COLORATION INCREASE
- STRESS/DISEASE MANAGEMENT

# HARVEST AID

- Dessicants



- Defoliants

- Boll Openers (enhancers/accelerants)





# Plant Defoliation

- In low desert agriculture this is mainly cotton
- There are a number of products such as DEF, ET, Sodium chlorate, etc.



Most products are single mode of action, but there are a few products that contain multiple modes, including an auxin transport inhibitor. That latter would be considered a plant growth regulator.



# Growth Regulators

- Products that slow/temporarily stop production of various plant hormones.
- There are a number of chemistries in this area.

# Plant Growth Regulators

- GIBBERELIC ACID INHIBITORS

- Mefluidide (Embark)
- Mepiquat Chloride (Pix, etc.)
- Prohexadione calcium (Apogee)
- Trinexapac-ethyl (Palisade, Primo Maxx, etc.)

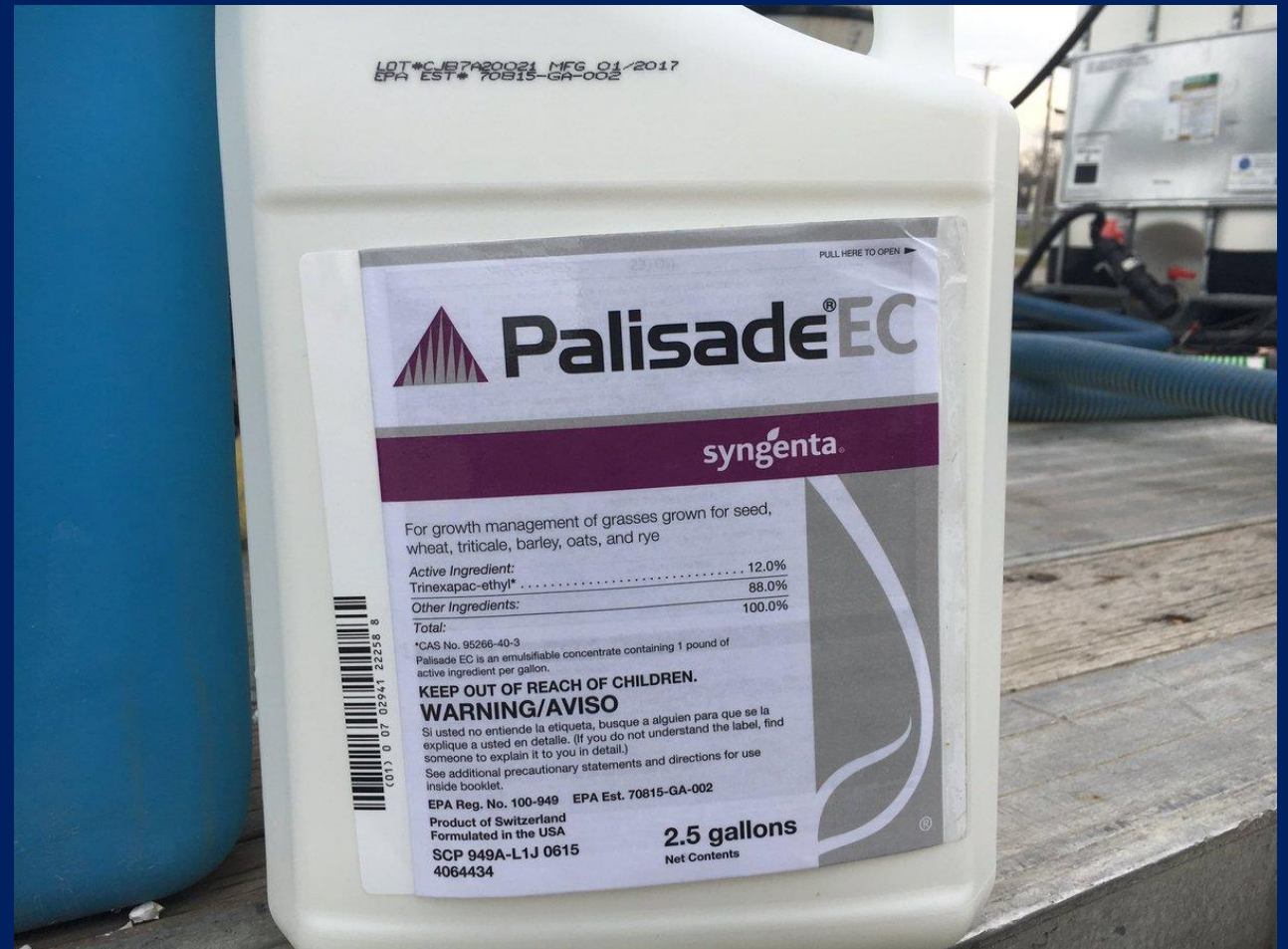
- AUXIN TRANSPORT INHIBITORS

- Cyclanalide

# Potential applications for PGRs (anti-GA products in local agriculture)

- Current widespread uses = cotton
- Some PGRs can prevent/lessen seed head development.
- Alfalfa seed production?
- Use in lawns/turf to reduce grass growth
- Cool Season Seed Crops – to prevent lodging and increased harvest efficiency (and potential higher yields) (wheat, small grains, etc.)
- Apples and other trees - vegetation management
- Possibility for increasing hay quality of cool season grasses?

# Recent Plant Growth Regulators



# Keeping cool season grass stems shorter by limiting GA production

- Shorter stems
- Less lodging
- Easier and faster harvest



Can we increase alfalfa quality by shortening internodes and do it economically?



The answer is “yes” and “no” (or is the correct answer “it depends”)

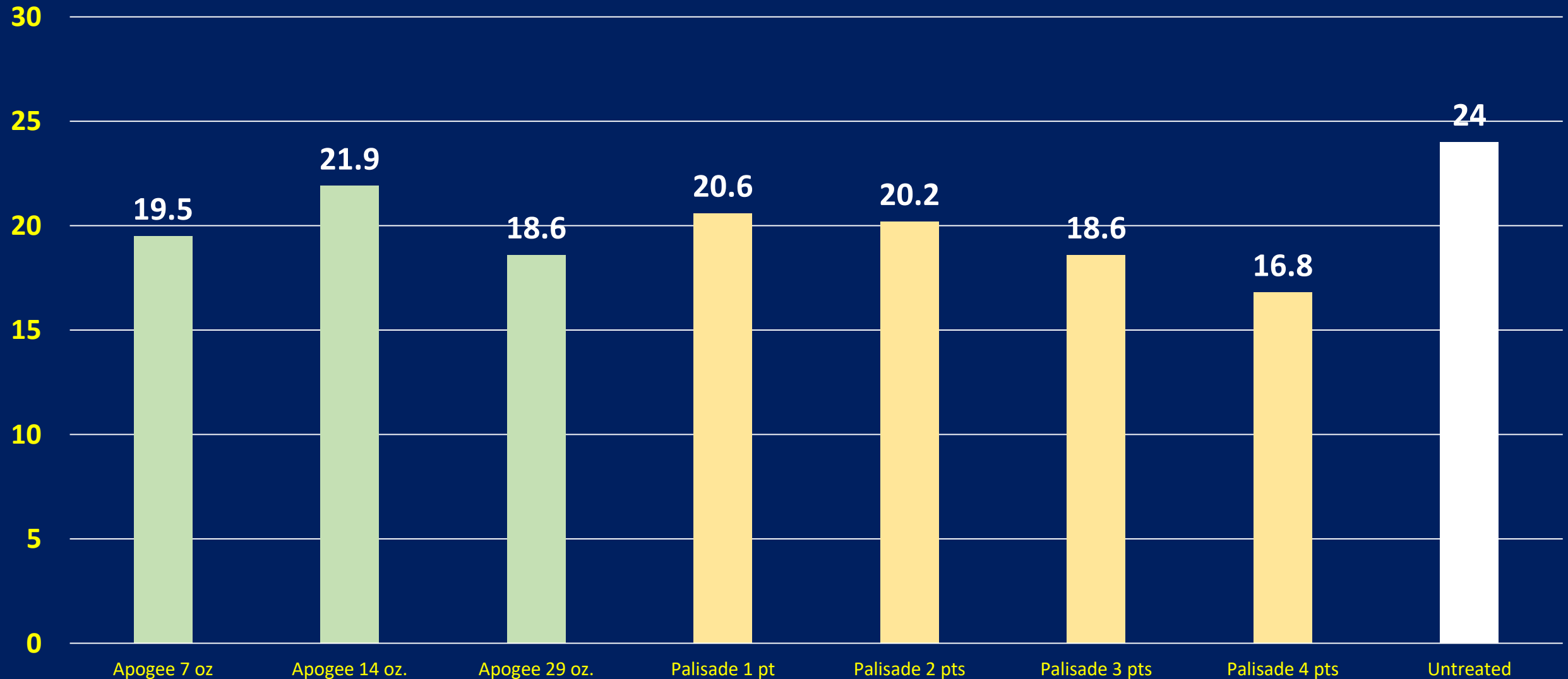
- Multiple cuttings involved over the summer, 1 application/cutting
- All PGR applications (Apogee) reduced yields
- Increase in May harvest quality from ‘good’ to ‘premium’, but not in other later summer harvests
- Price differential for the May cutting was not economical when only \$20/ton existed between good and premium quality classes

# Bermudagrass seed production and growth retardants:

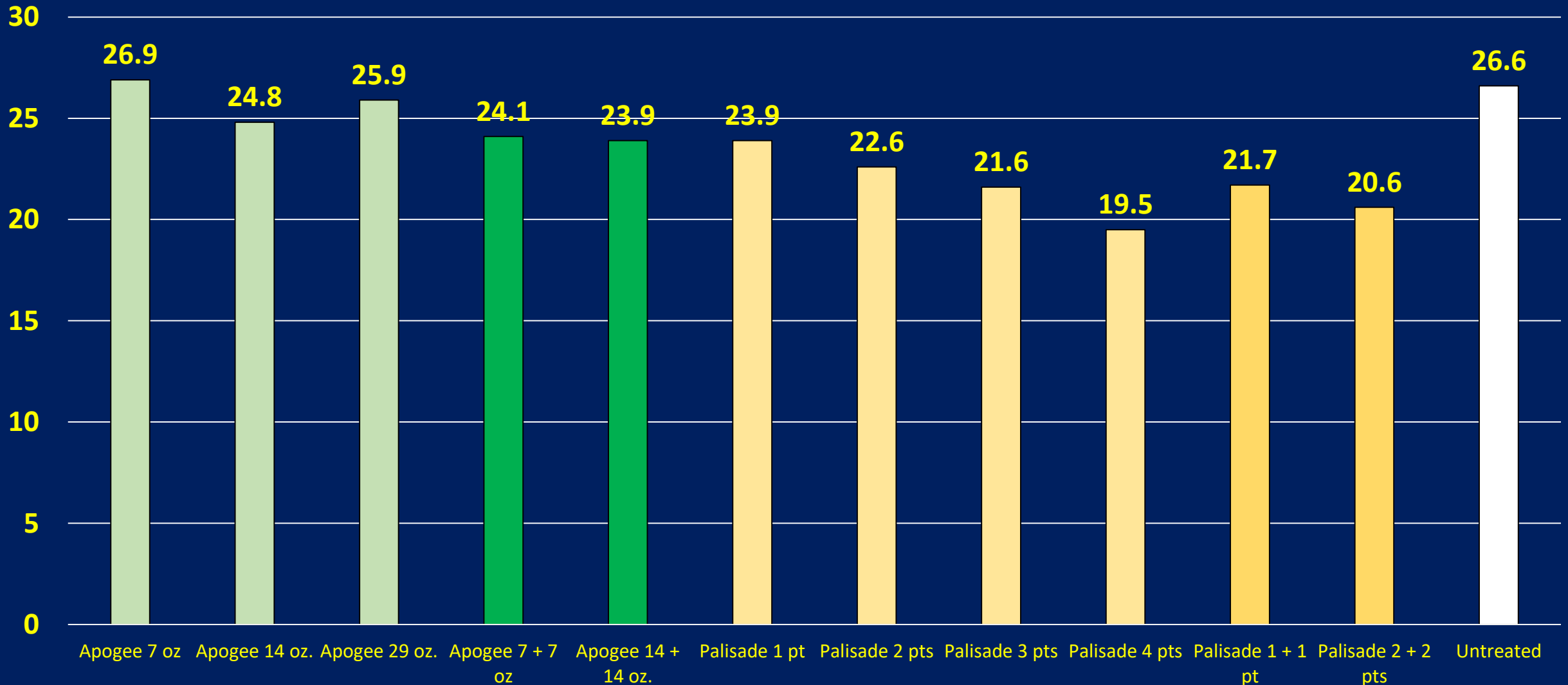
## Can we make harvest go faster by decreasing volume to be threshed?



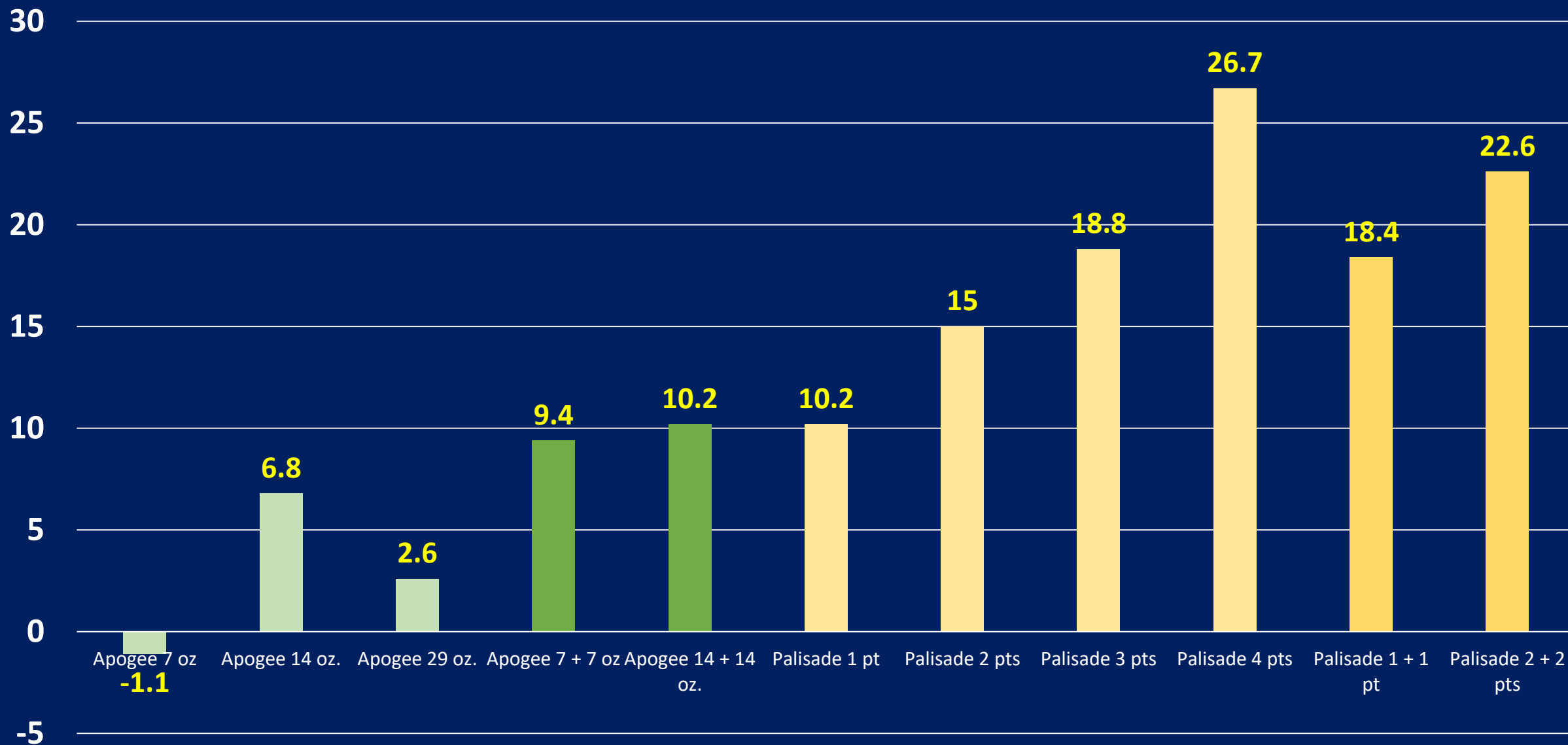
# Bermudagrass leaf height (cm) Oct. 3, following plant growth regulator application on September 18, 2003



# 'Cheyenne' Bermudagrass leaf height (cm) Nov. 7-8, following plant growth regulator application on September 18 and Oct.3, 2003



# 'Cheyenne' bermudagrass percent leaf height reduction Nov. 7-8, following plant growth regulator application on September 18 and Oct.3, 2003

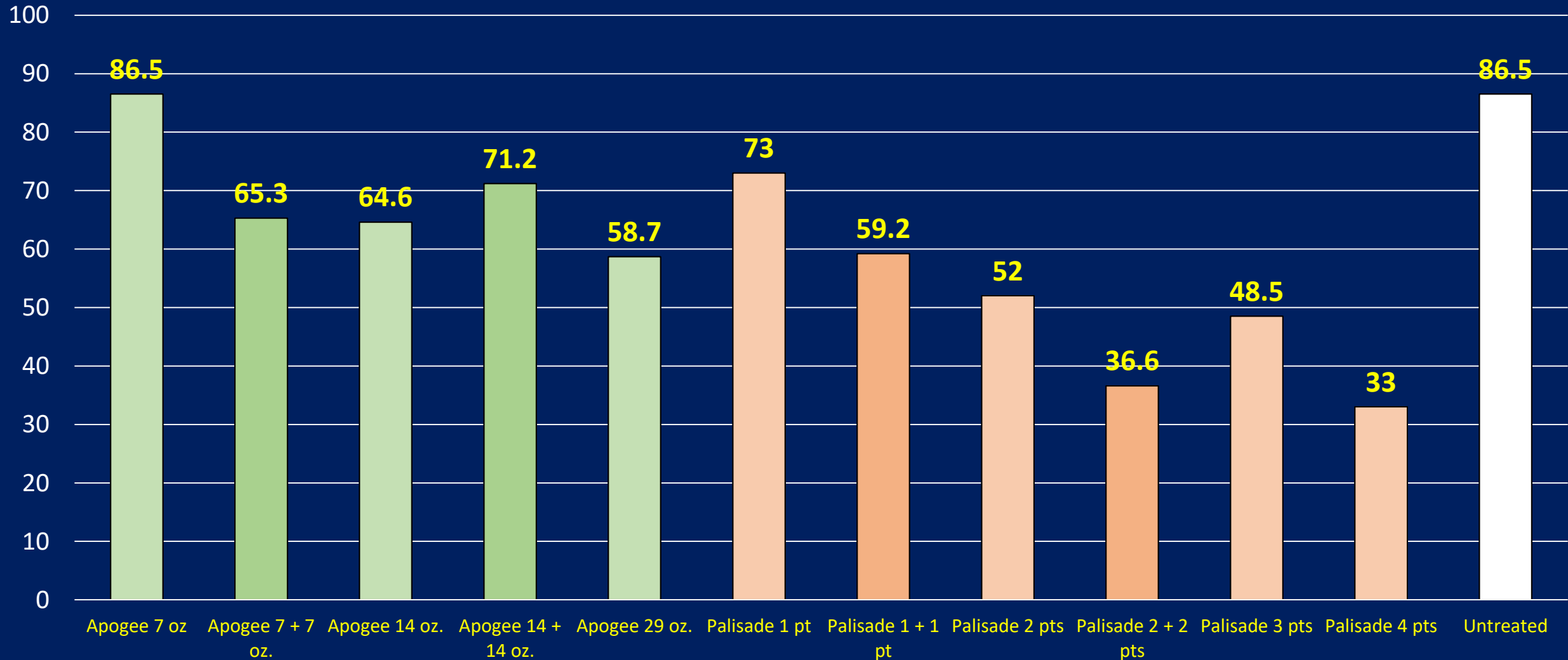




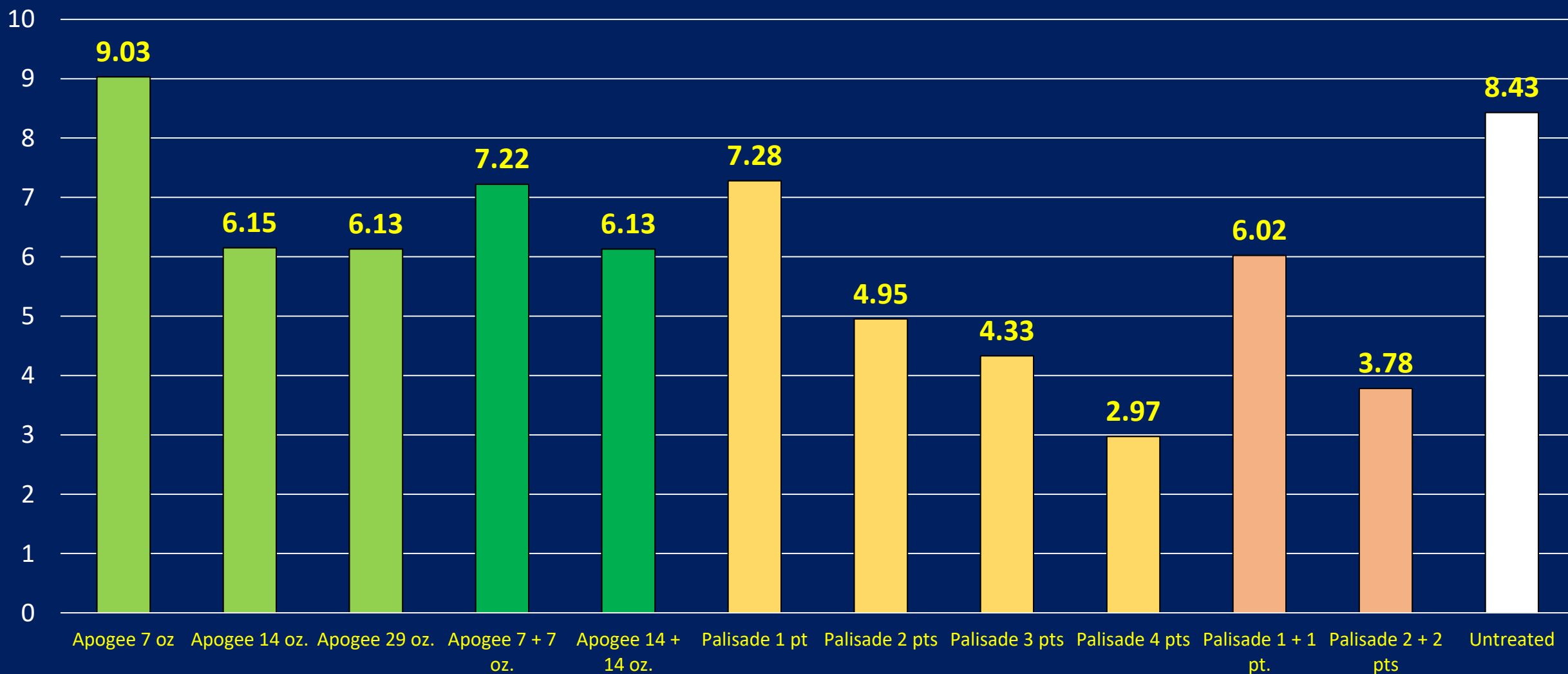
Faster seed combining speed (less stem to  
separate from seed) = Less Time in the field  
(& less wear and tear on combine)  
Time = \$\$\$

# 'Cheyenne' bermudagrass seed extended/open inflorescences/sq. ft. on Nov. 7-8 following application of Apogee or Palisade

*(Sept. 18, Oct. 3, 2004)*



# 'Cheyenne' Bermudagrass seed production (million seeds/acre) resulting from application of Apogee or Palisade

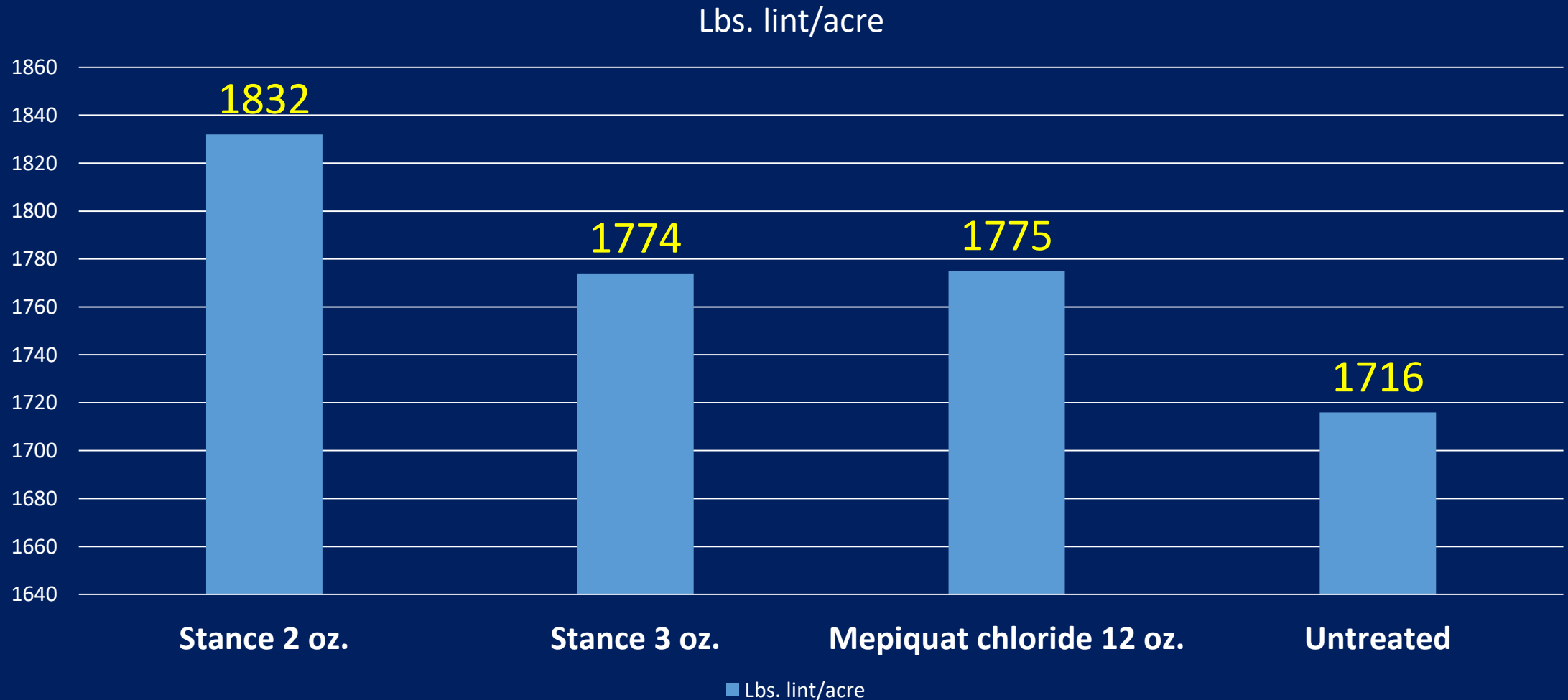


# What about combinations of growth inhibitors?



- Two active ingredients:
- 1) Cyclanalide (2.1%)
- 2) Mepiquat chloride (8.4%)

# DPL 164B2RF cotton response to Stance or Mepiquat Chloride application, Ripley, CA







What is  
easier  
to do?

# Build?



or Destroy?



It is easier to destroy than to build



# The same is true in biological systems!



=



It is much easier to kill/  
prevent/ reduce growth/other aspect



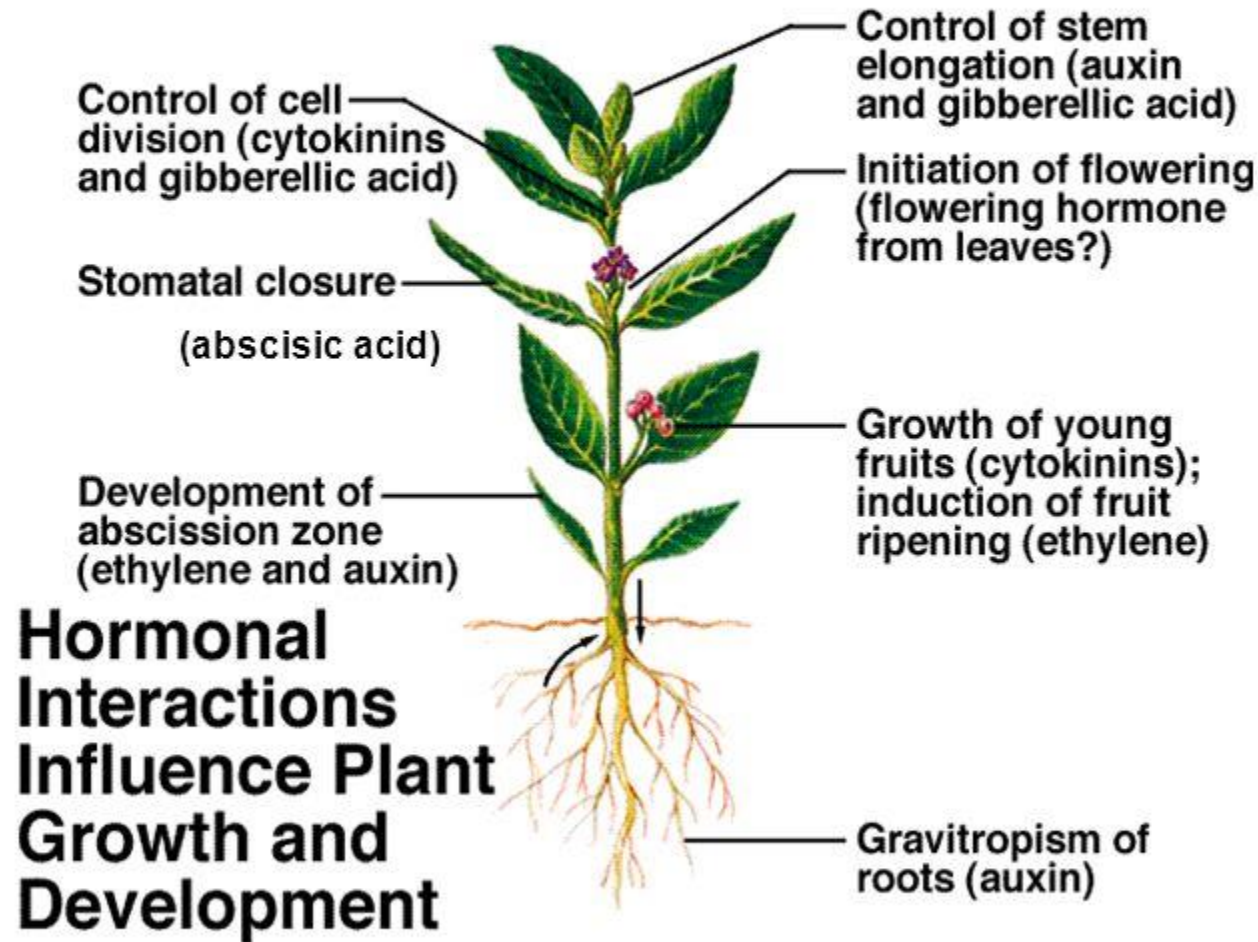
*It is much easier to kill/  
prevent/ reduce growth/other aspect*



*than it is to increase growth and yields*  
due to the multiplicity of systems involved.



# Plant hormones & growth



# There are multiple classes of plant hormones, with each class having multiple chemistries

## Historical/Traditional classes:

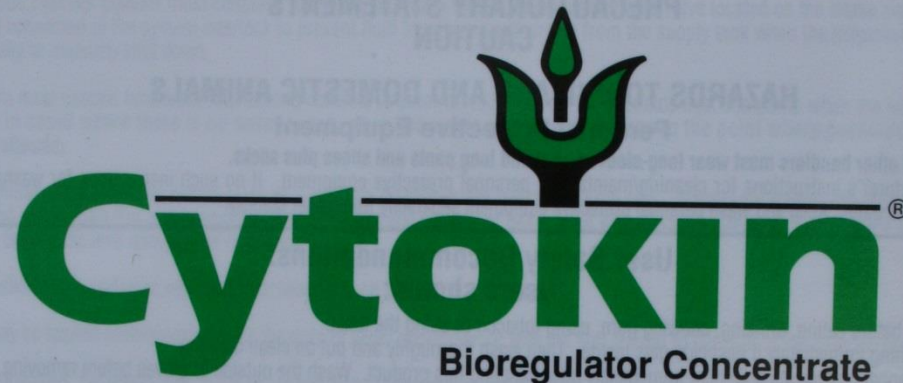
- Cytokinins
- Abscissic acid
- Gibberellic acids
- Ethylene
- Auxins

## More recently recognized classes:

- Brassinosteroids
- Oligosaccharides
- Polyamines (PAs)
- Complex Polymeric Polyhydroxyic Acids (CPPA)
- Others (?)
- GABA, Jasmonic Acids, etc.

# Major classes (very powerful hormones)

- Cytokinins
- Abscissic acid
- Gibberellic acids
- Ethylene
- Auxins



# Cytokinin<sup>®</sup>

## Bioregulator Concentrate

A Plant Bioregulator to Increase Crop Production Efficiency

### ACTIVE Ingredients:

Cytokinin, as kinetin, based on biological activity . . . . . 0.01%

#### Includes:

6-(4-hydroxy-3-methylbut-trans-2-enylamino)-purine

N<sup>6</sup>-methylaminopurine,

N<sup>6</sup>-dimethylaminopurine,

N<sup>6</sup>-isopentenylaminopurine

Other Ingredients . . . . . 99.99%

Total . . . . . 100.00%

### KEEP OUT OF REACH OF CHILDREN CAUTION

Harmful if swallowed or absorbed through the skin! Causes skin irritation! Do not breath vapor or spray mist. Do not get in eyes, on skin, or on clothing. Wash thoroughly with soap and water after handling.

#### Statement of Practical Treatment

If swallowed: Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person.

If on skin: Wash skin with soap and water.

If in eyes: Flush with plenty of water. Get medical attention if irritation persists.

### SEE INSTRUCTIONS FOR ADDITIONAL PRECAUTIONARY STATEMENTS

Produced for Plant BioTech, Inc., Deming, NM 88030 USA

EPA Registration Number 58199-1

EPA Establishment #211-KS-1

Net contents: 2.5 gallons (9.45 liters)

Net weight: 24 lbs. (10.8 kgs.)

©Cytokinin is a registered trademark licensed to Plant BioTech, Inc.

©Plant BioTech, Inc. 2004



## A PLANT HORMONE SUPPLEMENT

### Active Ingredients:

Cytokinin (as kinetin, based on bioassay) ..... 0.010%

#### Includes:

6-(4-hydroxy-3-methylbut-trans-2-enylamino)-purine

N<sup>6</sup>-methylaminopurine,

N<sup>6</sup>-dimethylaminopurine,

N<sup>6</sup>-isopentenylaminopurine

#### Auxin:

Indole-3-butyric acid ..... 0.005%

#### Gibberellin:

Gibberellic acid A<sub>3</sub> ..... 0.004%

Other Ingredients ..... 99.981%

Total ..... 100.000%

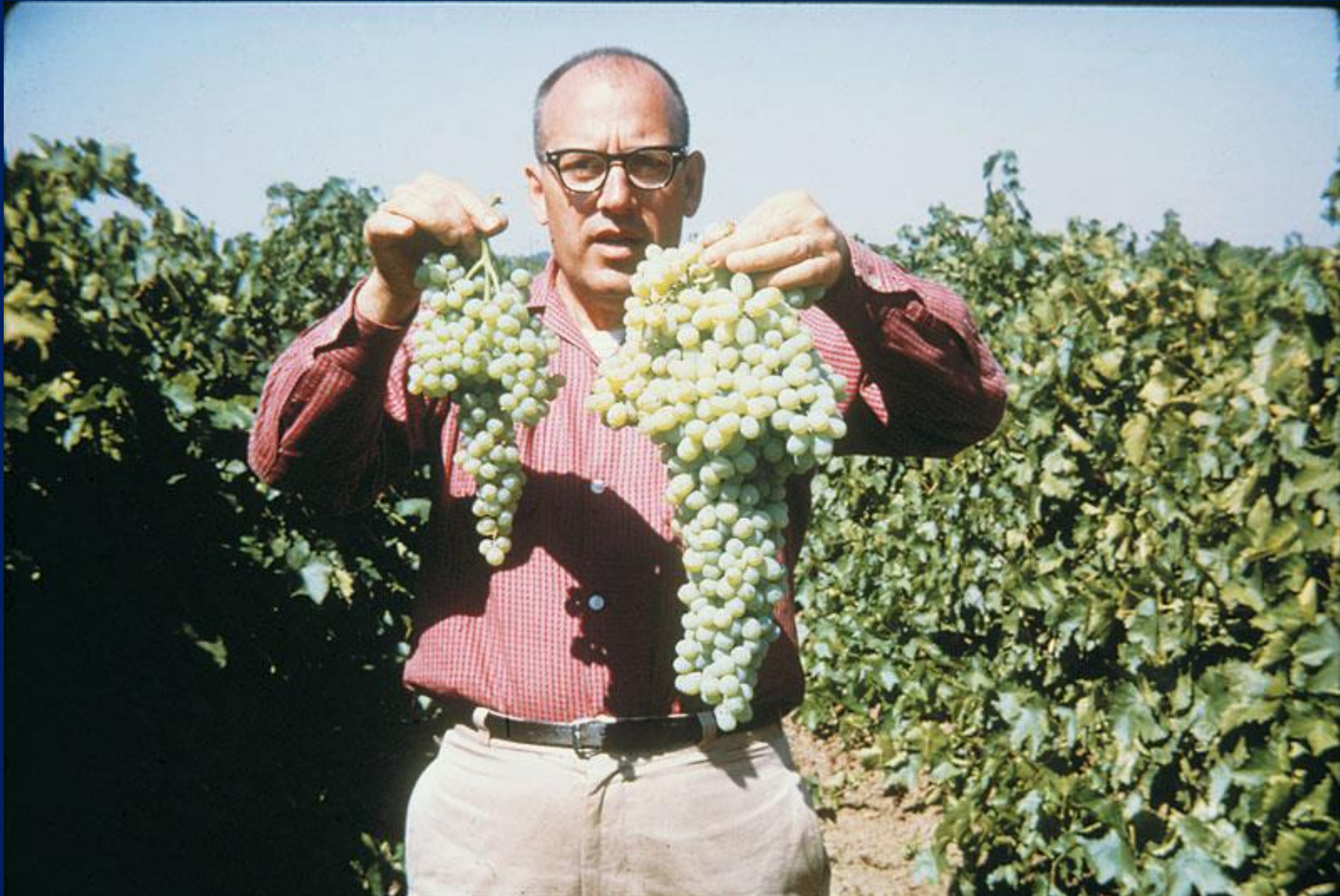
**KEEP OUT OF REACH OF CHILDREN**

**CAUTION**

Harmful if swallowed or absorbed through the skin! Causes skin irritation! Do not breath vapor or spray mist. Do not get in eyes, on skin, or on clothing. Wash thoroughly with soap and water after handling.

**Statement of Practical Treatment**

# Effects of GA<sub>3</sub> on grape size





**Gibberellic Acid Treated Seedless Grapes**

# RyzUp SmartGrass



- Gibberellin A<sub>3</sub>
- Product used to increase grass re-growth in rotational grazing systems in New Zealand, etc.
- This formulation initially used in southeastern U.S. on winter pasture grasses



# Factors that Effect and Biostimulant/Growth Enhancement Effects

- Crop
- Crop Variety
- Biostimulant Rate
- Herbicide
- Growing Environment
- Surfactant
- Timing and Application Method
- Fertility Levels

# Growth Response differences to plant hormones and biostimulants



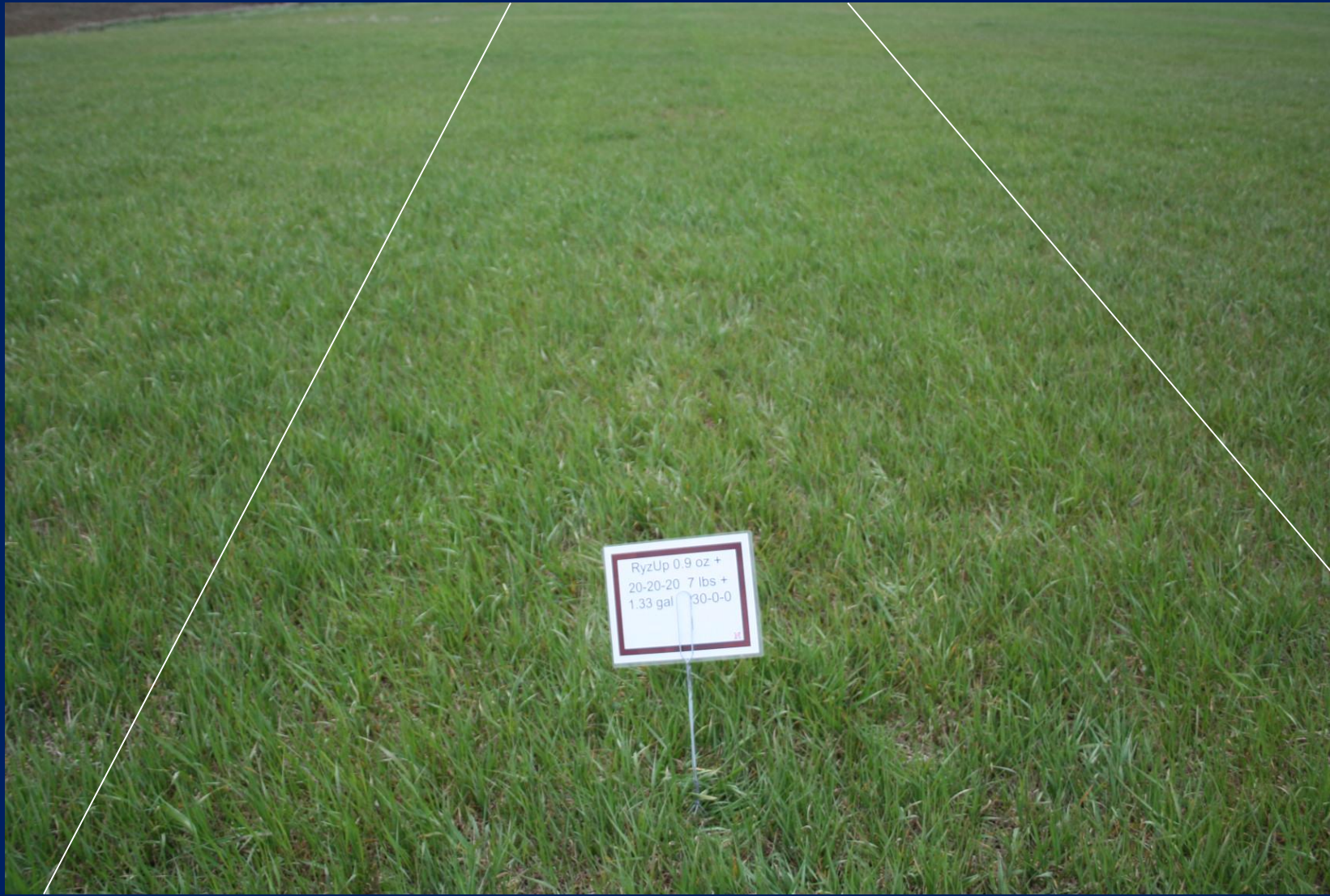
# Rate Study – Smooth Brome

*0.3, 0.6 and 0.9 oz./acre*



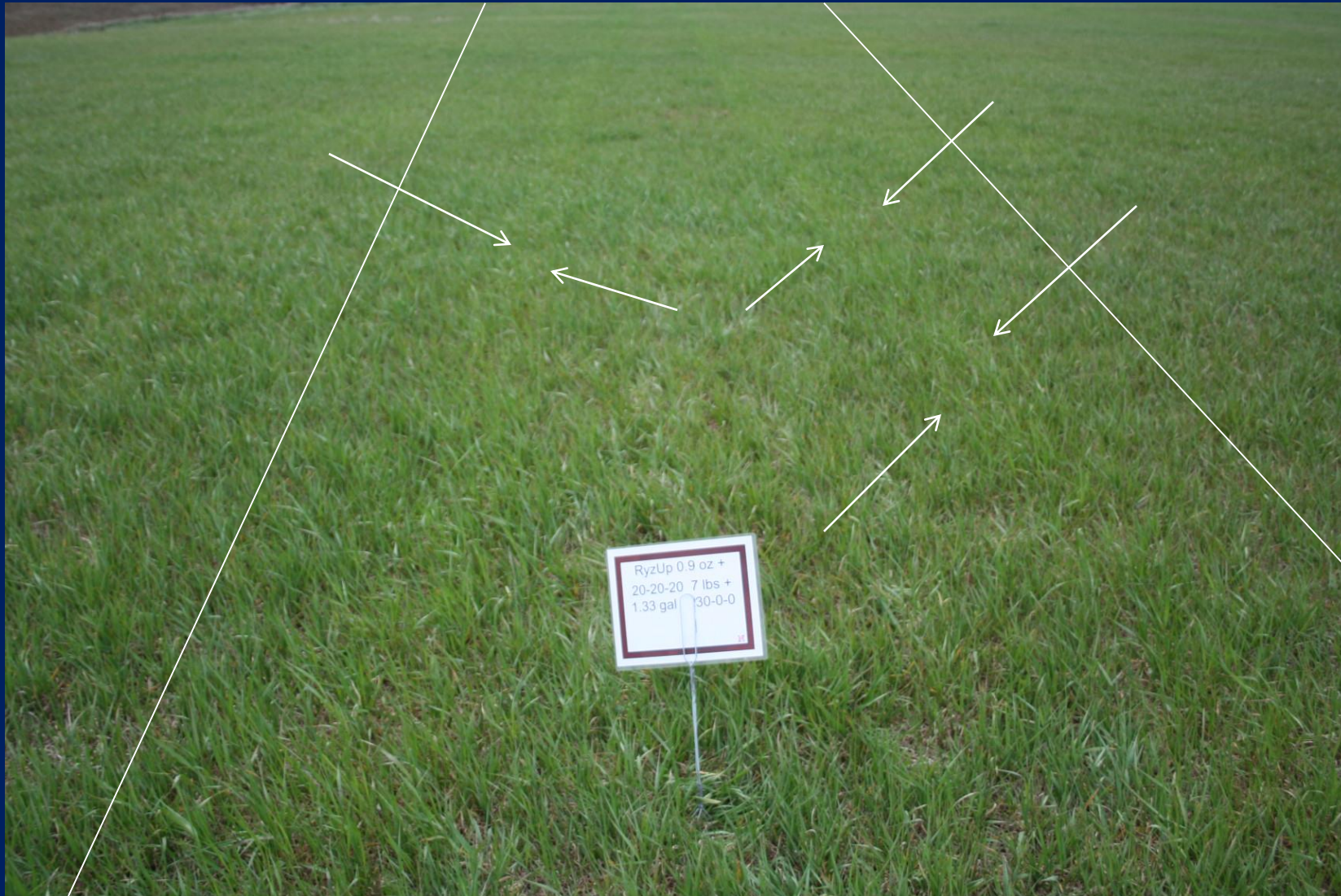
# Rate Study – Large Plots

## Strange things happening!



# Smooth Brome Rate Study

## Strange things happened!



13 DAT

Differences due to surfactant used with product



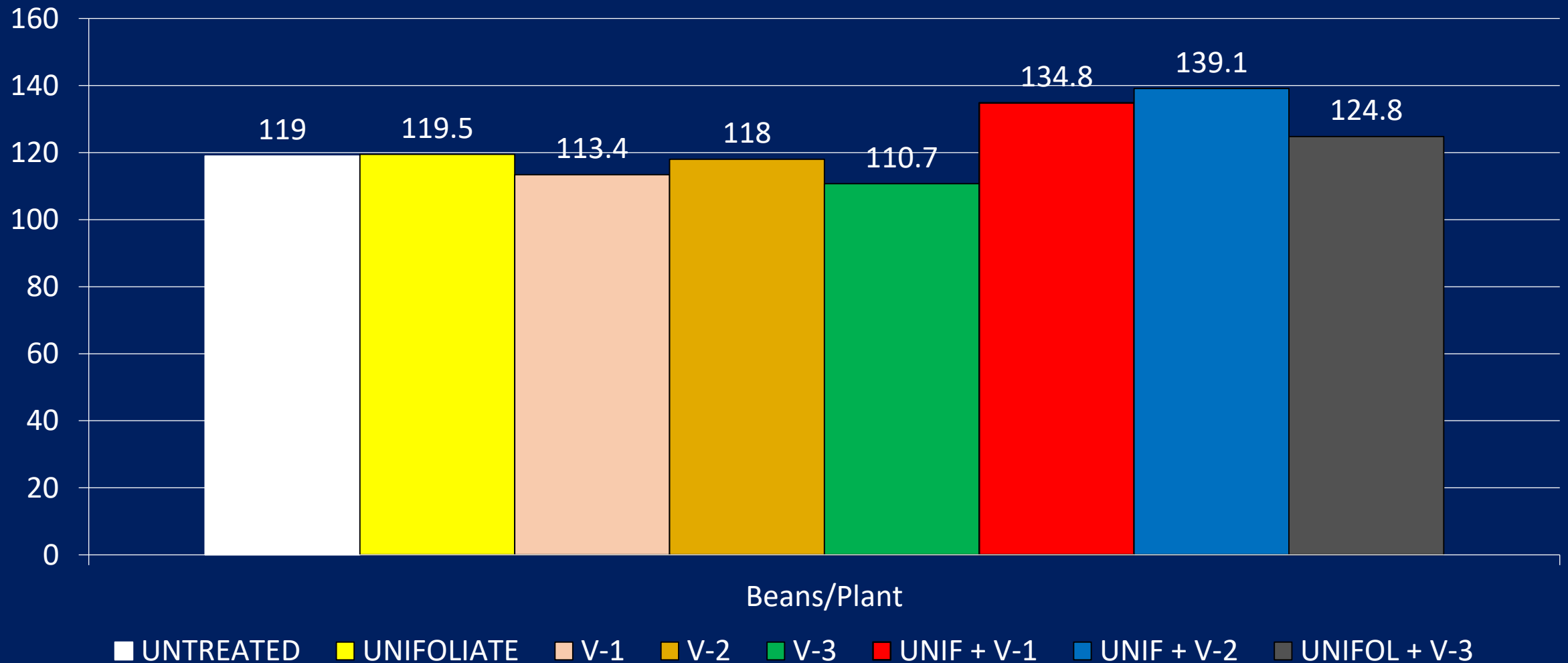
# Factors that Effect and Biostimulant/Growth Enhancement Effects

- Crop
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- Growing Environment
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- Timing and Application Method
- Fertility Levels

# Soybean growth differences at 8 days post treatment



# Mean Soybeans/Plant at Harvest Resulting from Gibberellic Acid (GA-3) Application at Various Stages of Early Development, Rising City, Nebraska, 2016



# There are multiple classes of plant hormones, with each class having multiple chemistries

## Major classes:

- Cytokinins
- Absciscic acid
- Gibberellic acids
- Ethylene
- Auxins

## More recently recognized: Minor classes:

- Brassinosteroids
- Oligosaccharides
- Polyamines (PAs)
- Complex Polymeric Polyhydroxyic Acids (CPPA)
- Others on the periphery GABA, Jasmonic Acids, etc.



Do chemicals that signal the plant to grow  
(rather than reduce plant growth) actually bridge the gap between  
“potential” and “reality of increased profits”?



A photograph of a grassy field with several yellow and blue markers placed on the ground, likely for a research plot. In the background, there is a wooden fence and a clear sky.

There are lots of products out there that claim to increase plant growth.

*Do any of them provide **consistent and economical** production returns?*

# Low Desert Cotton Results

## Mixed chemistries

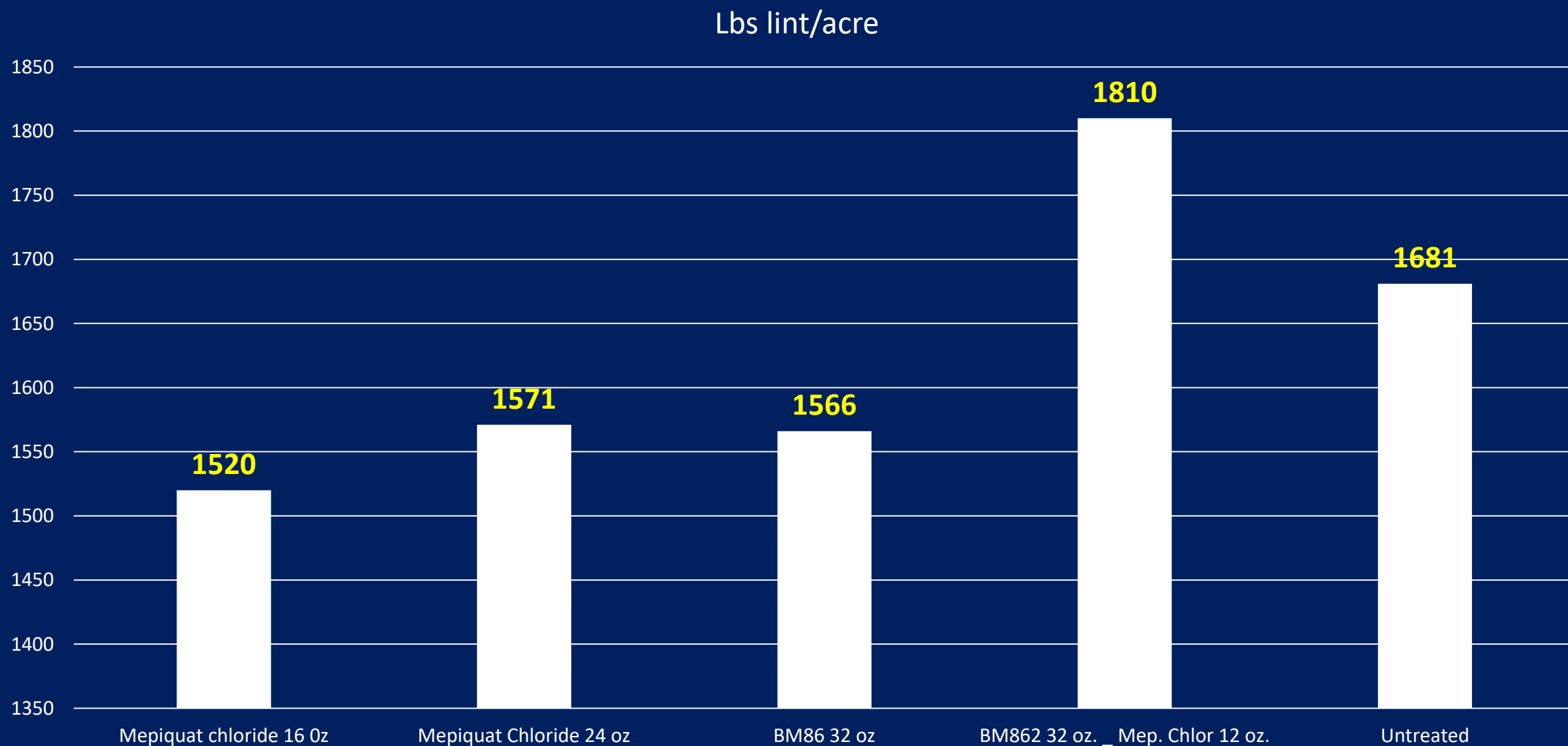


# BM86 - Polyamine related product

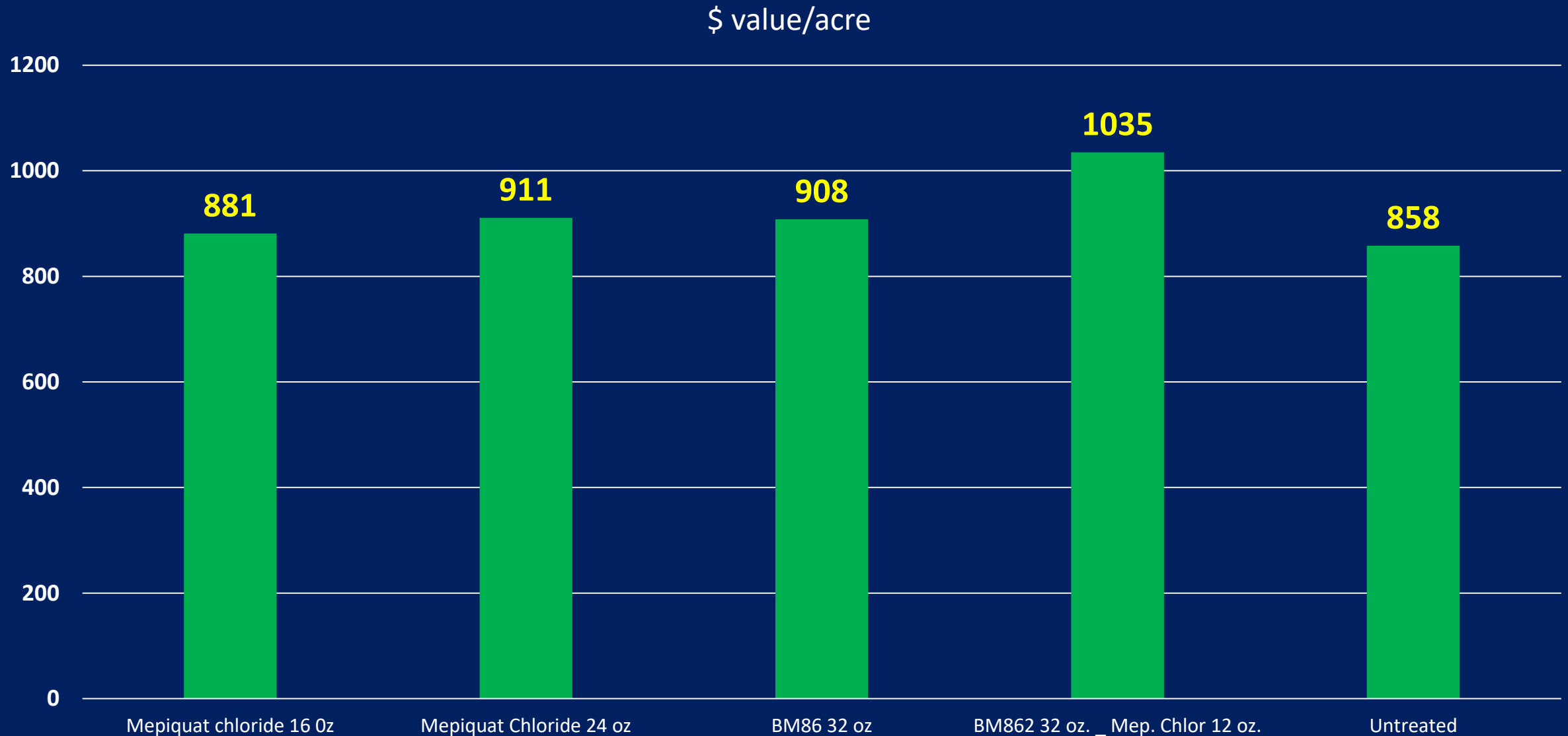
- Contains GA 142
- Strengthens flower structures responsible for pollination
- Enhances cell formation
- Promotes production of polyamines and other substances that are necessary for a wide range of metabolic reactions
- Provides a nutrient package that efficiently aids in the conversion of photosynthates to carbohydrates and in protein synthesis



# Polyamine (PA) low desert research results



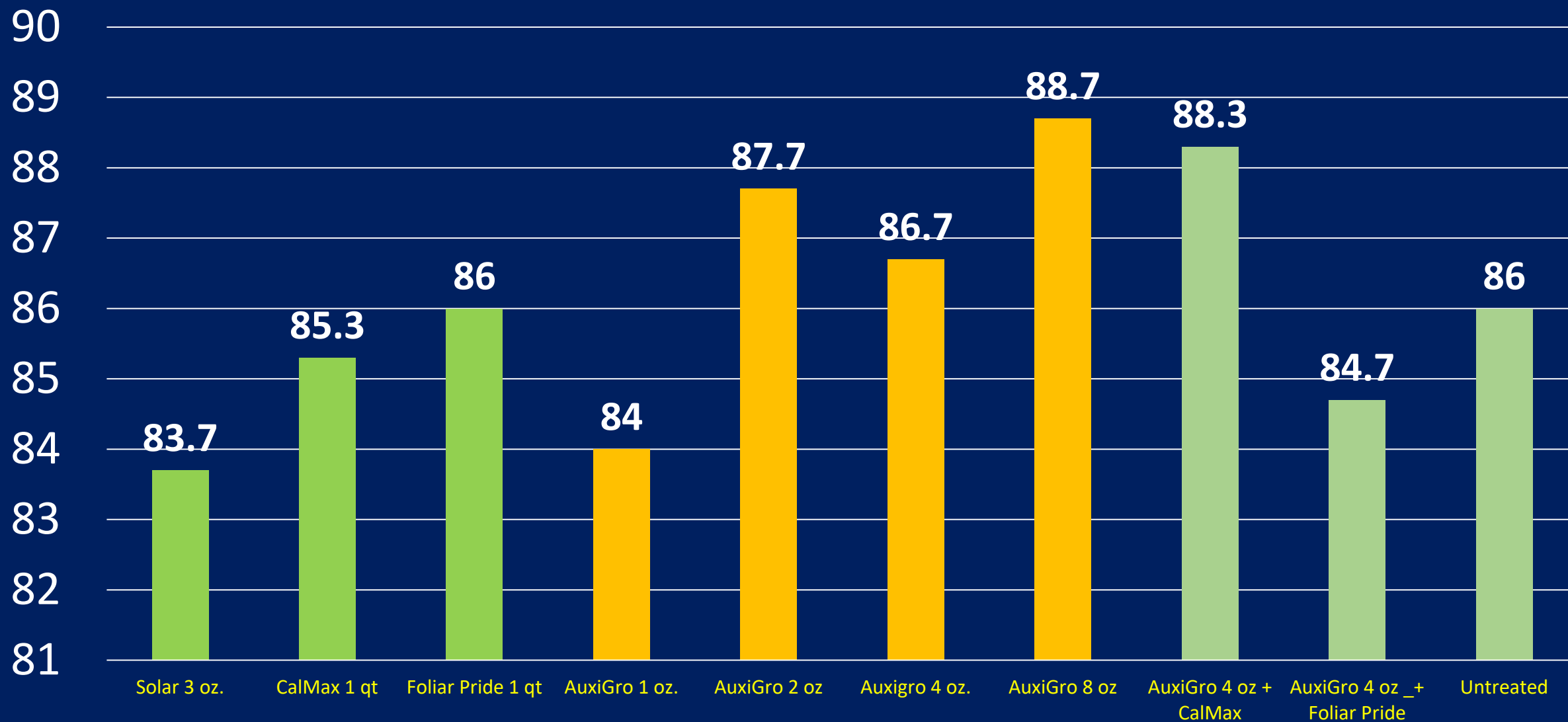
# Polyamine (PA) low desert research results



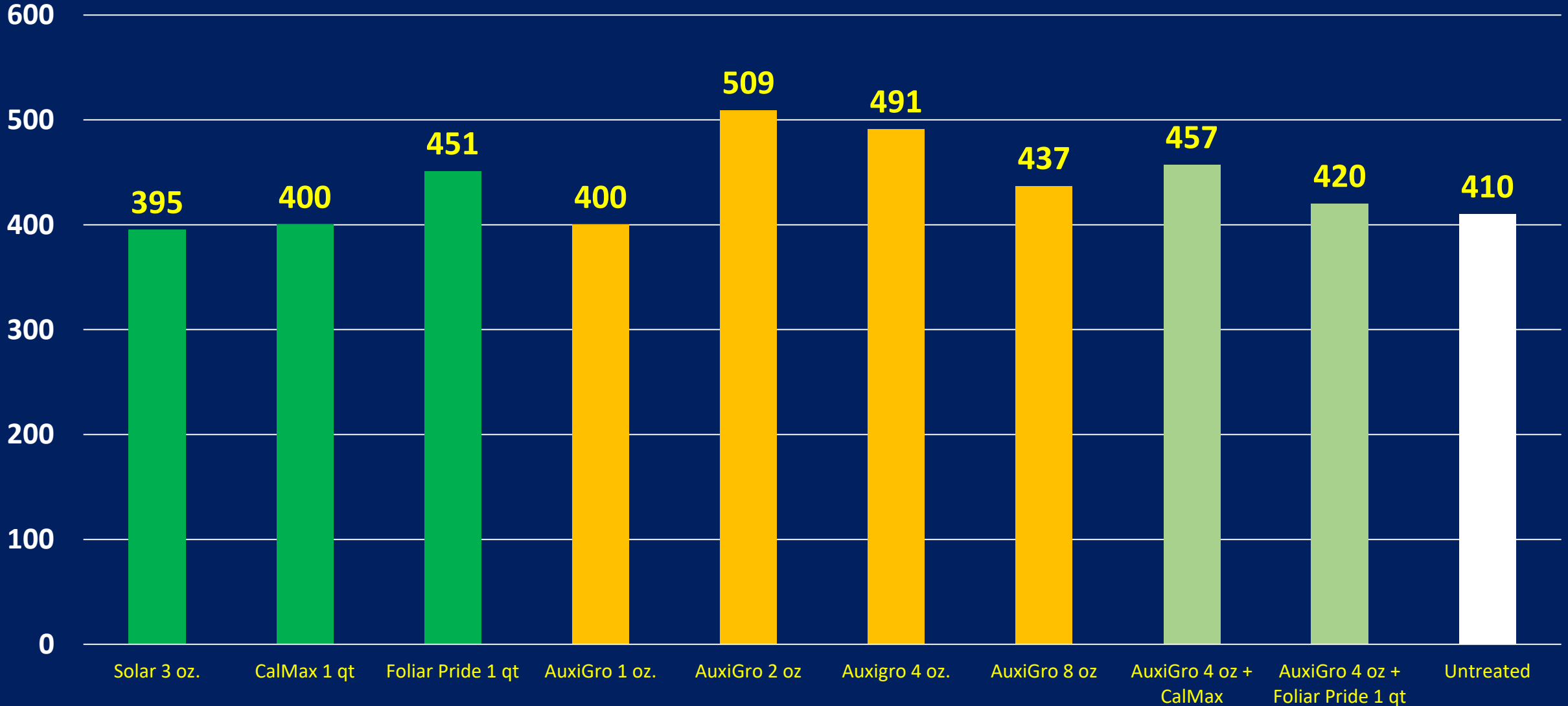
# Bermudagrass seed production and plant growth regulators Can we increase yields with GABA?



# Bermudagrass seed germination percentages following treatment with GABA and/or surfactants



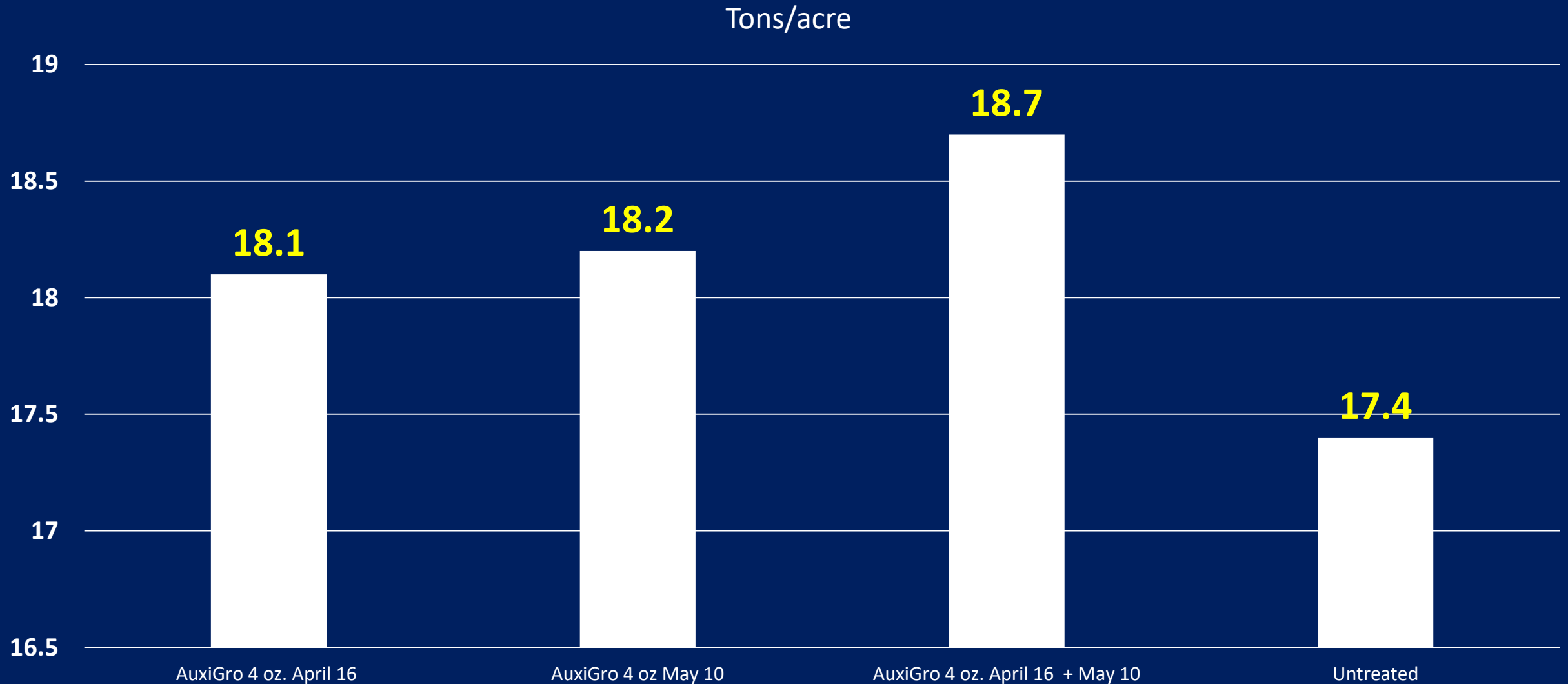
# Bermudagrass seed yields (lbs. Pure Live Seed/acre) following GABA application on June 8, 2004, Blythe, CA



# Dehydrator onion response to GABA



# Tons dehydrator onion yields/acre at harvest following GABA application



# Jasmonic Acid pathway/SAR

- SAR refers to the Systemic Activated Response
- This response helps plants to fight disease, and is often valuable in other aspects.



**Messenger**  
Field Trial Number 200038 Date 5/14/02  
Crop Melon Variety Santa Claus  
Treatment Grouer Standard  
Application Rate         
Field/Farm Identification Fisher Ranch  
Comments Field 202  
Blythe, CA EDEN

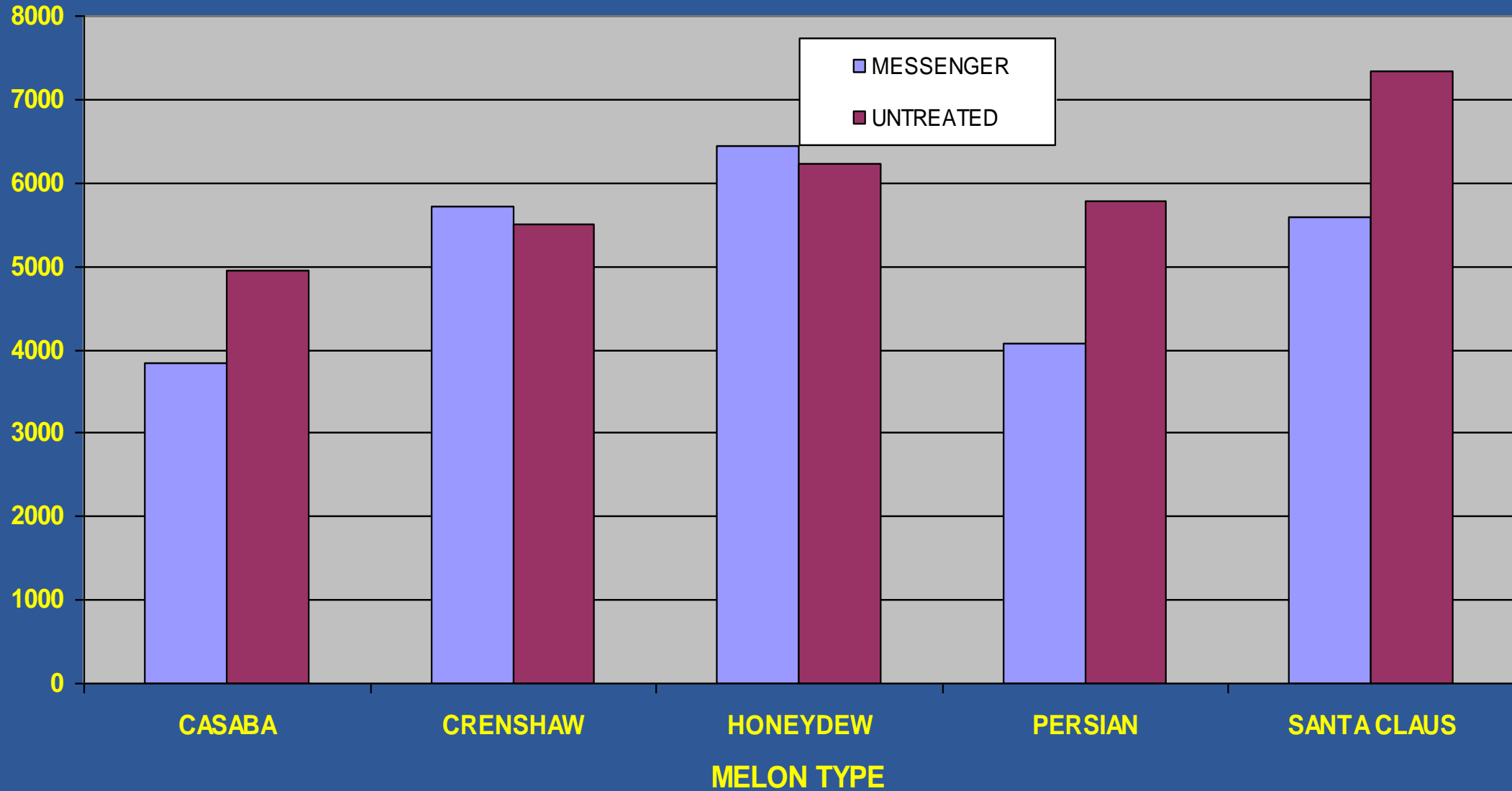
**Messenger**  
Field Trial Number 200038 Date 5/14/02  
Crop Melons Variety Santa Claus  
Treatment Messenger  
Application Rate 3 Apps @ 4.5 oz  
Field/Farm Identification Fisher Ranch  
Comments Field 202  
Blythe, CA EDEN



**Messenger®**  
Field Trial Number: 200038 Date: 5/14/02  
Crop: Melon Variety: Crenshaw  
Treatment: Grower Standard  
Application Rate: \_\_\_\_\_  
Field/Farm Identification: Fisher Ranch  
Comments: Field 202  
Blythe, CA 

**Messenger®**  
Field Trial Number: 200038 Date: 5/14/02  
Crop: Melons Variety: Crenshaw  
Treatment: Messenger  
Application Rate: 3 Apps @ 4.5 oz  
Field/Farm Identification: Fisher Ranch  
Comments: Field 202  
Blythe, CA 

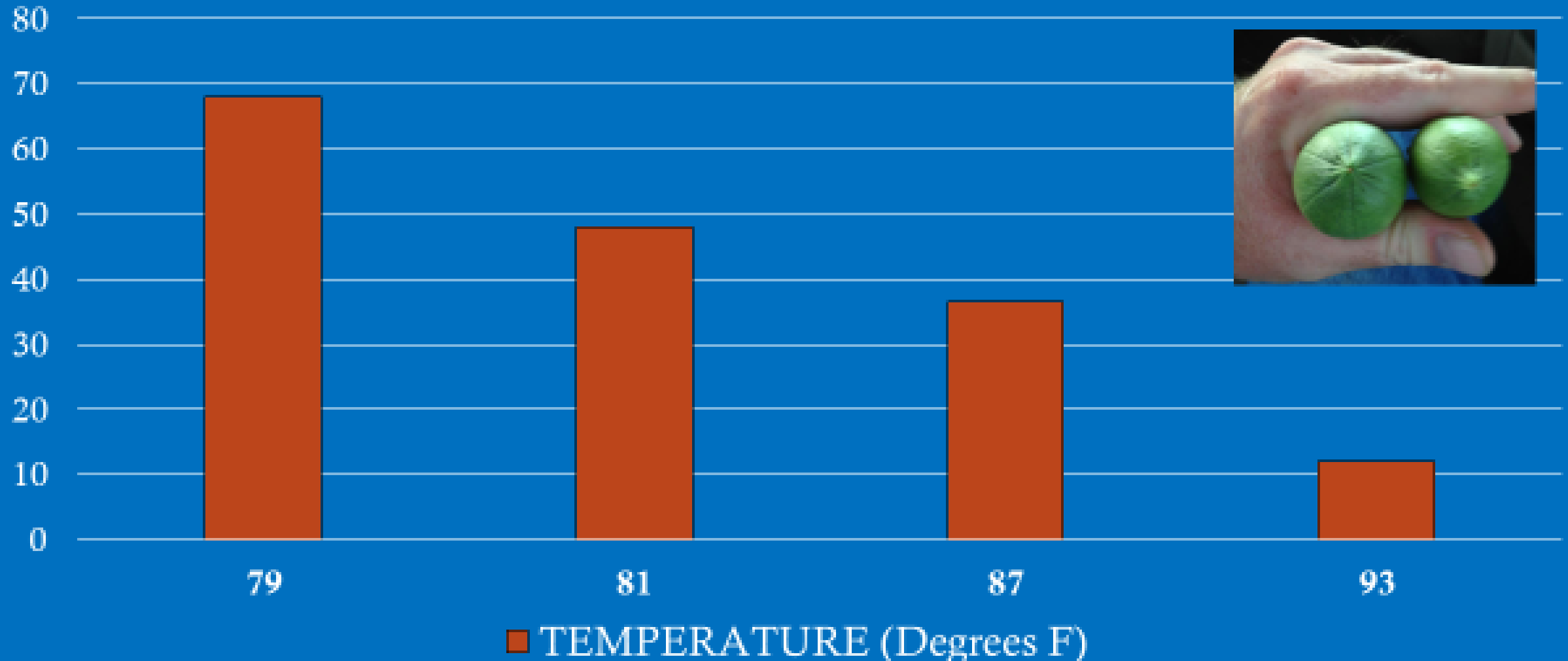
# NUMBER OF MARKETABLE MELONS PER ACRE



# AntiStress Products

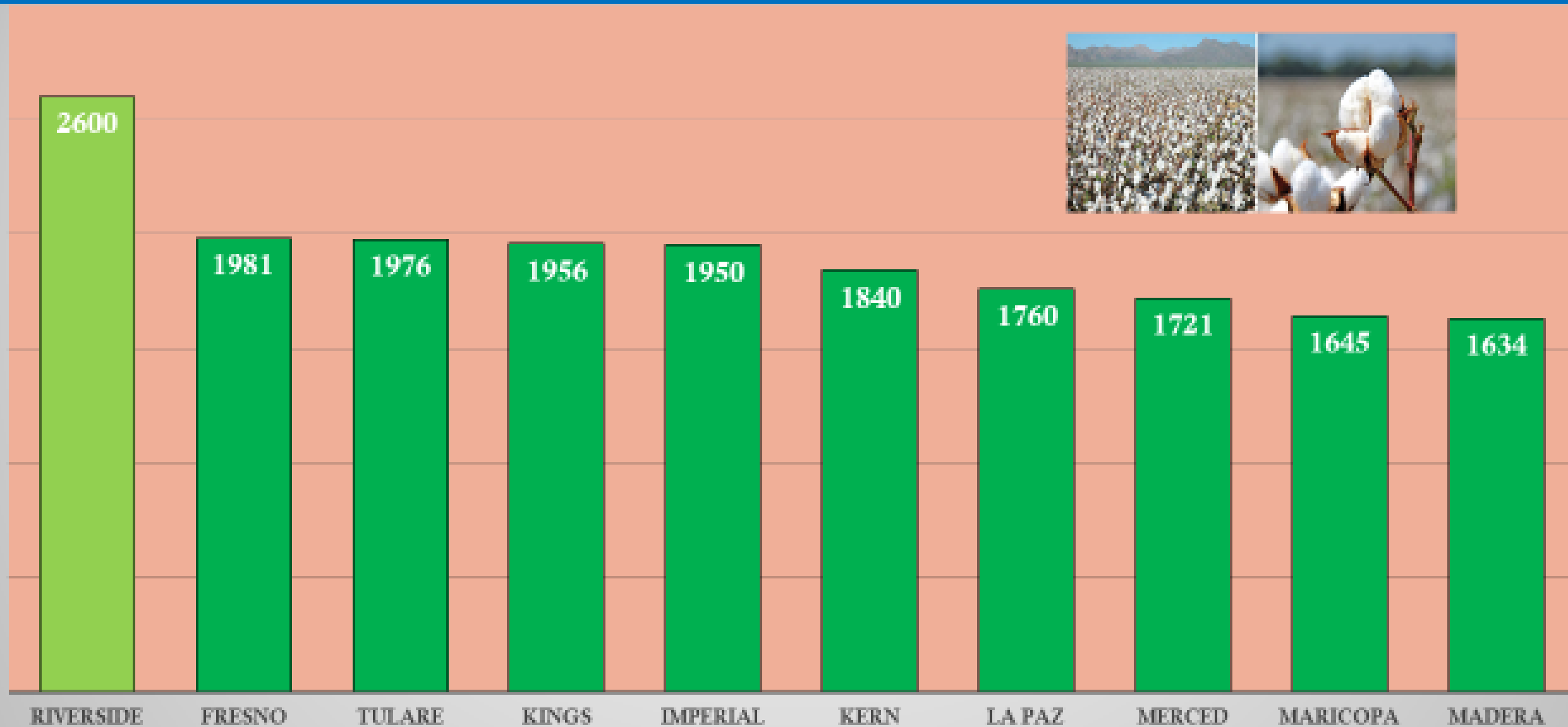
- Stress leads to free radical molecules being produced within plants
- Unless neutralized, the free radical molecules will signal for ethylene production
- Higher ethylene levels in plants then signal for the formation of abscissic acid
- In cotton, abscisic acid causes developing flowers and bolls to be abscised (dropped from plant)

# Fruit Retention of DPL 5415 Cotton Grown in Growth Chambers at Various Mean Temperatures during Primary Bloom Cycle



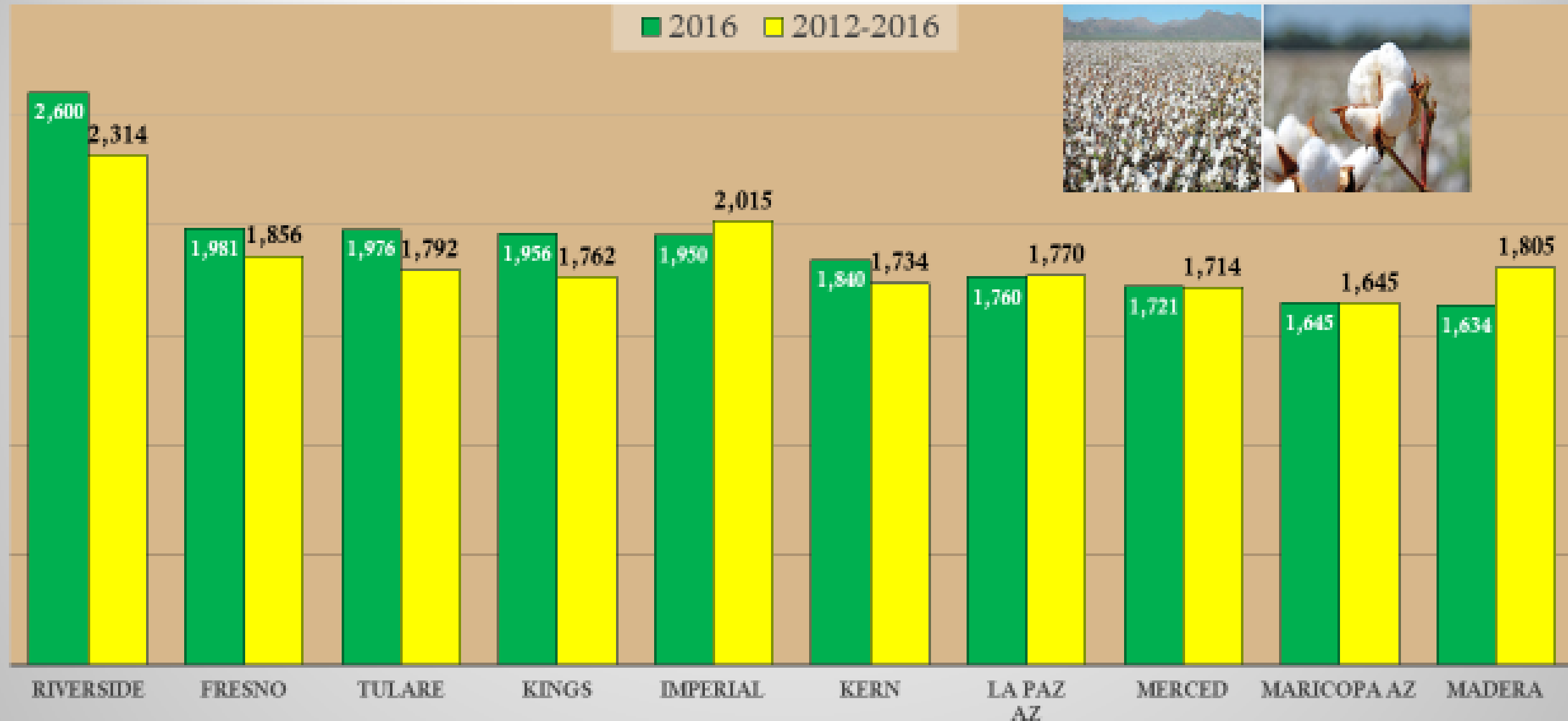
# County Upland Cotton Lint Yields *(Pounds/Acre)*

## 2016 National Leaders



# County Upland Cotton Average Lint Yields *(Pounds/Acre)*

## 2012-2016 National Leaders



Areas with the highest yields also have the highest risk potential for crop yield reduction.



Several products that are marketed for their anti-ethylene properties

The logo for INVINSA, featuring the word "INVINSA" in a black, serif, all-caps font. The letters are widely spaced and set against a plain white background.

INVINSA



# Anti-Ethylene mode of actions

- **Retain** – (AVG) cotton locally, walnuts and tree crops (ethylene biosynthesis blockers)
- 1-MCP (Ethylene compound that inhibits the action of ethylene)  
**Invinsa**



# Area research thus far has been with ReTain

- Applied latter part of July to four local cotton varieties
- This was probably too late in the season
- A rate effect was noted (some positive differences, others negative)
- Since applied so late in season, may have missed much of the early stress, thus additional testing is probably necessary, especially as varieties have changed

# Some plant growth regulation thoughts for the future

- With an ever increasing emphasis on water, will plant growth regulation products provide increased efficiency/water conservation?

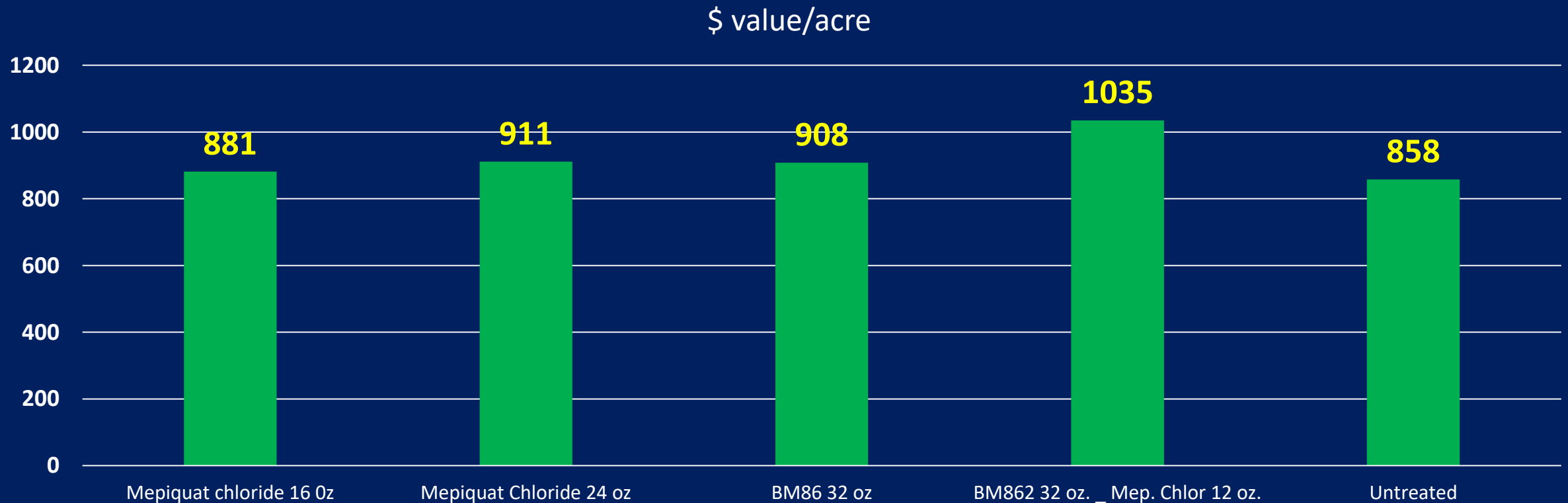


Can we increase alfalfa quality with PGRs and reduce water use at the same time at certain times of the year?



# Some plant growth regulation thoughts for the future

What is the synergism between various chemistries, such as noted for BM86 + mepiquat chloride?



Some products now on market that have multiple chemistries (Cyclanalide in both)



# Some plant growth regulation thoughts for the future

- With new chemistries and products being introduced into the marketplace every year, it is difficult to evaluate all potential aspects of plant growth regulation chemistries, especially when interactions exist for variety, surfactant, and other environmental factors.

Questions?