Micronutrients, Biostimulants and PRGs to Increase Yields in Soybeans

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2019 Soybean Summit

Brandt Specialty Division

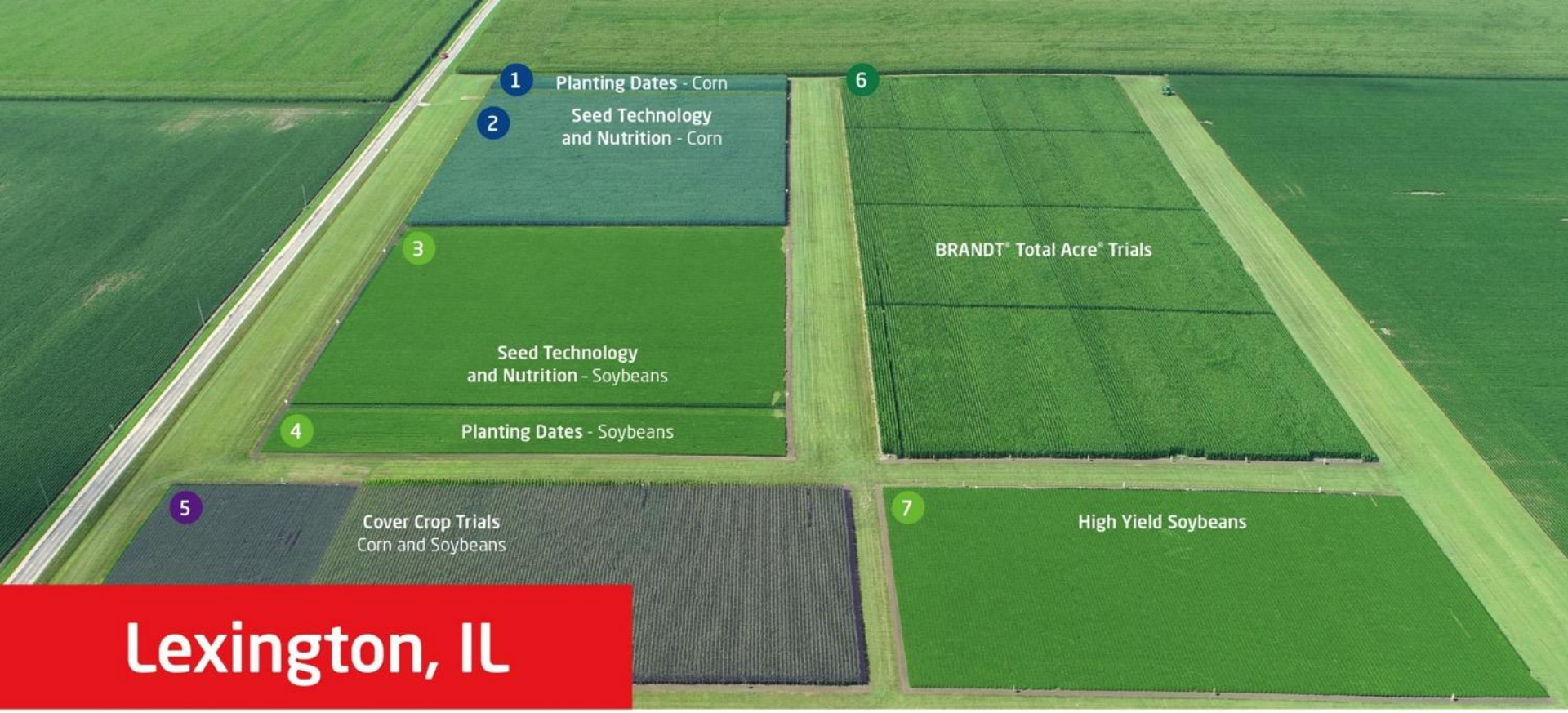
BRANDT

Pleasant Plains, IL

Omission Trials - Standard Treatment

Fall NH_3	Spring NH_3	Total Nutrition	Planting Date	Population	Harvest Date
150 Units	150 Units	**Corn:** 190-50-150-20S **Soybeans:** 15-50-150-20S	4/23/18 - 4/25/18	**Corn:** 42,000 **Soybeans:** 120,000	9/4/18 - 10/1/18

Fungicide/Insecticide/Nutrition Application	Herbicide/Nutrition Application
Corn: Hero®, BRANDT® Smart B-Mo, Delaro™ **Soybeans:** Hero, BRANDT Smart Trio®, BRANDT Smart B-Mo & Quadris®	**Corn:** (Pre-emergent) Resicore®; (Post-applied) BRANDT Smart Trio & BRANDT Smart B-Mo **Soybeans:** (Pre-emergent) Boundary®; (Post-applied) Glyphosate, BRANDT Smart Trio & BRANDT Smart B-Mo



Lexington, IL

Omission Trials - Standard Treatment

Total Nutrition	Planting Date	Population	Harvest Date
Corn: 200-69-150-20S **Soybeans:** 18-46-120-20S	4/27/2018 - 4/30/2018	**Corn:** 39,000 **Soybeans:** 130,000	9/17/2018

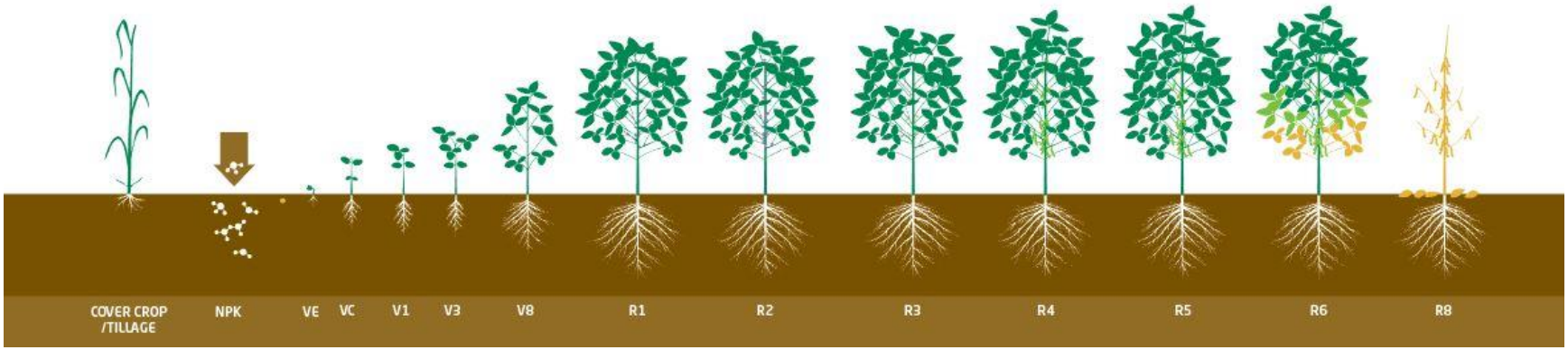
Fall NH_3	Preplant 28%	At Plant Nutrition	Side Dress 28%
Corn: 140 Units - with N-Serve	60	0	0

Fungicide/Insecticide/Nutrition Application	Herbicide/Nutrition Application
Corn: Trivapro®, Warrior II with Zeon Technology®, Lorsban®, BRANDT Smart Trio, BRANDT Smart B-Mo **Soybeans:** Trivapro, Warrior II with Zeon Technology, Lorsban, BRANDT Smart Trio, BRANDT Smart B-Mo, N-Boost® 5	**Corn:** (Pre-emergent) Acuron® (Post-applied) Halex® GT, BRANDT Smart Trio & BRANDT Smart B-Mo **Soybeans:** (Pre-emergent) Boundary (Post-applied) Engenia®, Roundup WeatherMax®, BRANDT® Smart Sulfur Plus

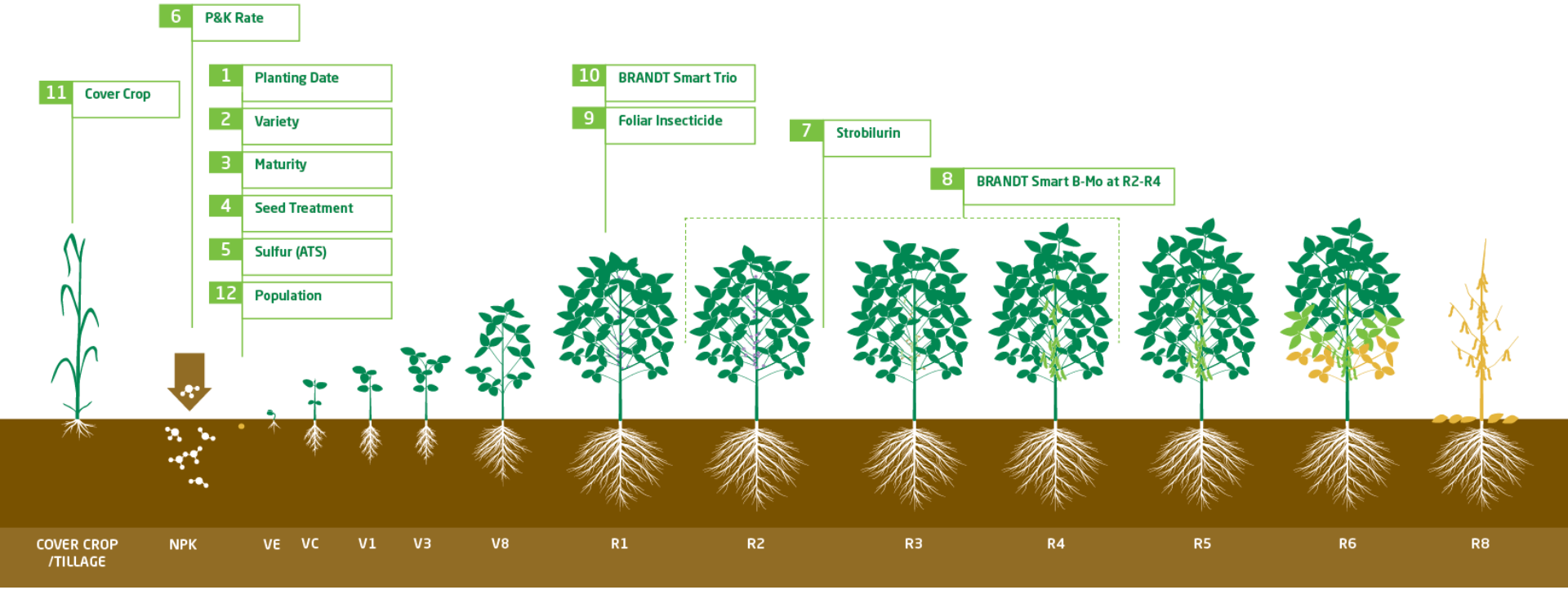
BRANDT Total Acre Pole Positions

BRANDT Total Acre is an omission style trial system that is focused on exposing the differences between variety phenotypes. The “omission design” is based on providing all the treatments and then removing one to see what value each practice has on yield of that phenotype. This creates an environment where the yield responses reflect the total high management system rather than a limited response due to some or all the parts of the system.

- 15-50-150 suspension in fall
- 120,000 population
- 7 gal/ac ATS at plant (2x0)
- BRANDT Elite seed treatment
- Conventional tillage
- Boundary burn down prior to plant - 4/12/2018
- Post applied herbicide tank mixes + BRANDT Smart Trio or Brandt Smart Quatro Plus + BRANDT Smart B-Mo at 3rd trifoliate
- Foliar insecticide at R1 plus 1 qt/ac BRANDT Smart Trio + 1 pt/ac BRANDT Smart B-Mo
- Strobilurin at R3/insecticide + 1 pt/ac BRANDT Smart Trio + 1 pt/ac BRANDT Smart B-Mo



BRANDT Total Acre Pole Positions

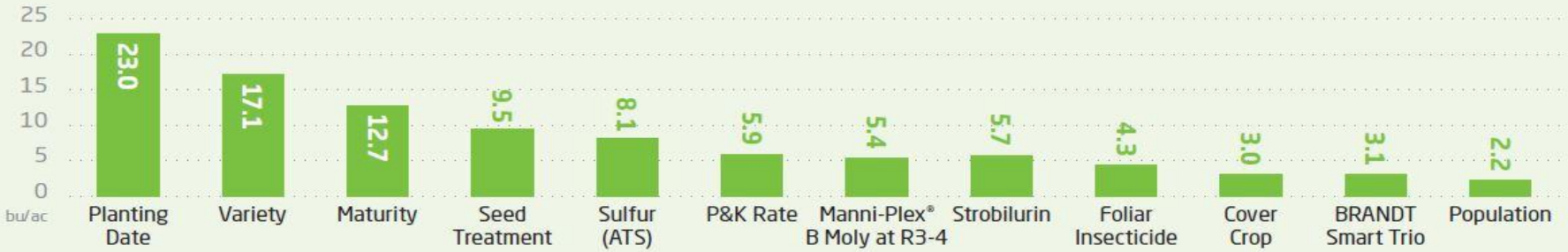


BRANDT Total Acre Pole Positions

	BRANDT Total Acre Pole Positions	2011	2012	2013	2014	2015	2016	2017	2018	8 yr Avg	8 yr ROI
1	Planting Date	n/a	6.8	8.3	13.6	11.0	45.3	51.8	23.9	23.0	$$$
2	Variety	25.6	14.6	19.3	17.5	7.0	12.4	23.5	16.7	17.1	$$$
3	Maturity	17.0	10.2	13.0	8.5	0	12.4	23.5	16.7	12.7	$$$
4	Seed Treatment	6.1	11.9	7.4	5.5	8.5	12.9	7.5	16.3	9.5	5.3
5	Sulfur (ATS)	n/a	n/a	3.8	4.8	4.8	8.8	12.2	14.1	8.1	6.2
6	P&K Rate	1.6	3.5	4.0	5.2	n/a	n/a	15.4	n/a	5.9	1.0
7	Strobilurin	n/a	4.0	3.1	6.5	3.2	9.1	4.2	10.0	5.7	2.9
8	BRANDT Smart B-Mo at R2-R4	n/a	n/a	1.0	7.4	n/a	2.0	10.3	6.3	5.4	9.3
9	Foliar Insecticide	3.5	5.7	4.9	3.4	n/a	2.9	5.1	n/a	4.3	5.2
10	BRANDT Smart Trio	3.2	3.9	3.4	3.3	n/a	n/a	2.0	2.8	3.1	5.9
11	Cover Crop	n/a	n/a	n/a	n/a	9.5	0	1.4	-2.0	3.0	1.6
12	Population	2.5	2.8	3.6	0	n/a	n/a	n/a	n/a	2.2	1.9

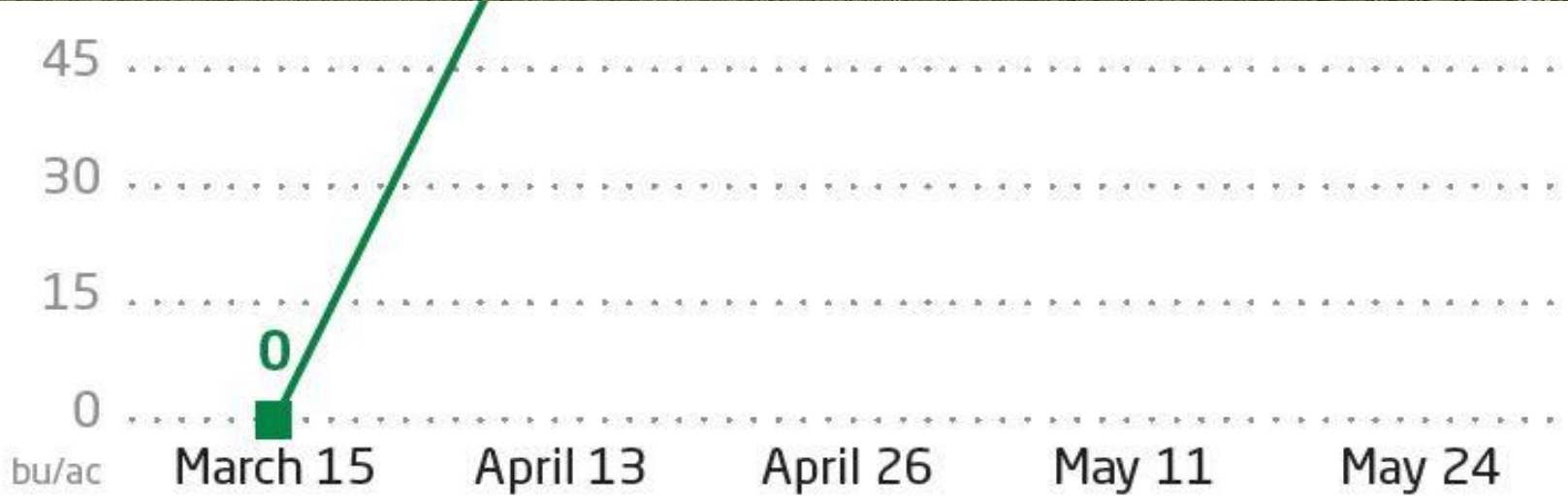
The ROI (Return On Investment) listed is calculated using the 2018 fall crop insurance price of $8.60 per bushel, multiplied by the yield response per acre, minus the cost per acre of a practice. For every dollar invested per acre in a practice, the ROI factor is how many dollars you get in return. We use a symbol of $$$ for practices that had no measurable cost per acre, but offer the best ROI.

8 Year Average Yield Advantage

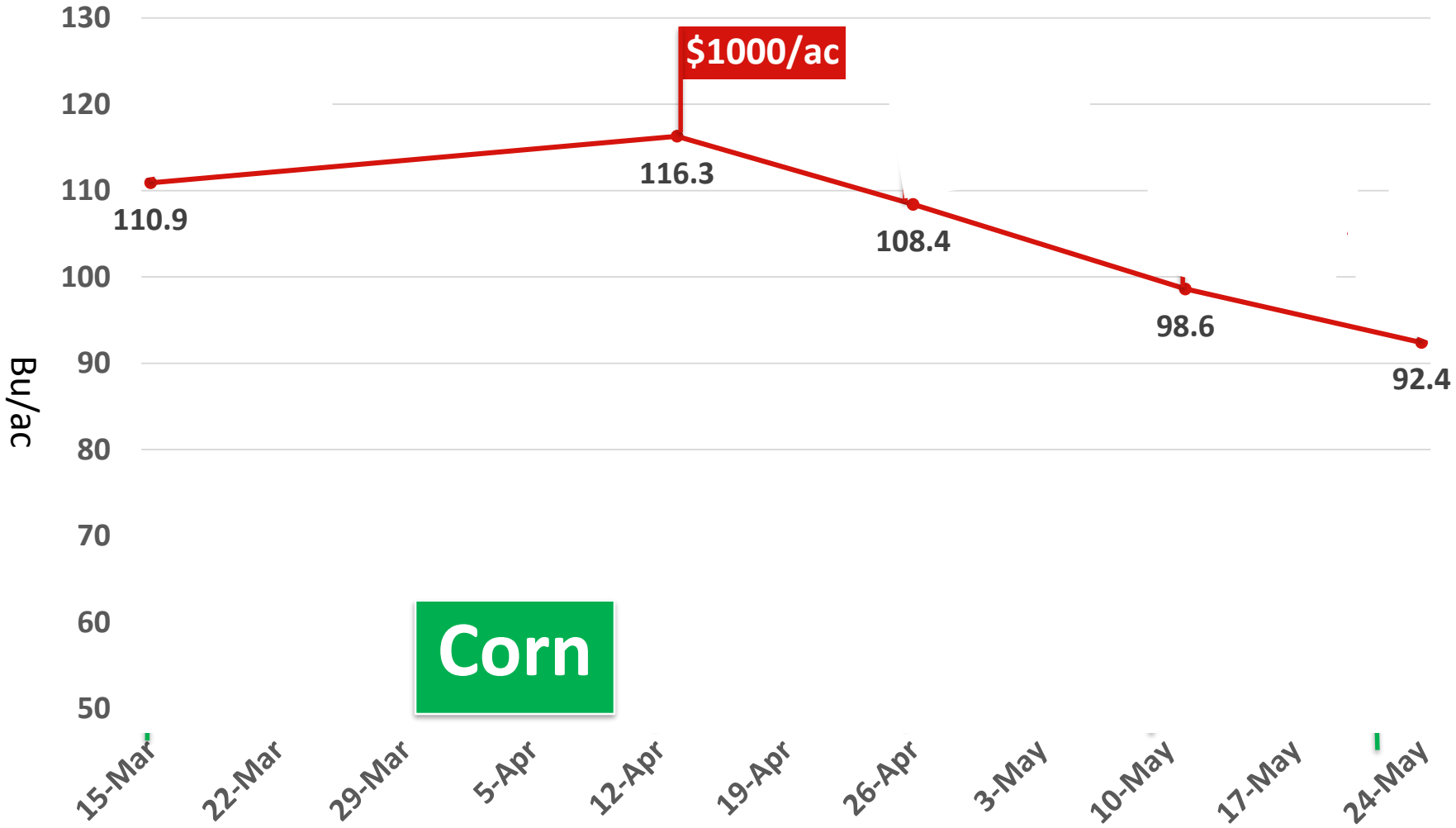


Pleasant Plains

Elite Treated



$8.60/bu.


130
120
110
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Corn
15-Mar
22-Mar
29-Mar
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12-Apr
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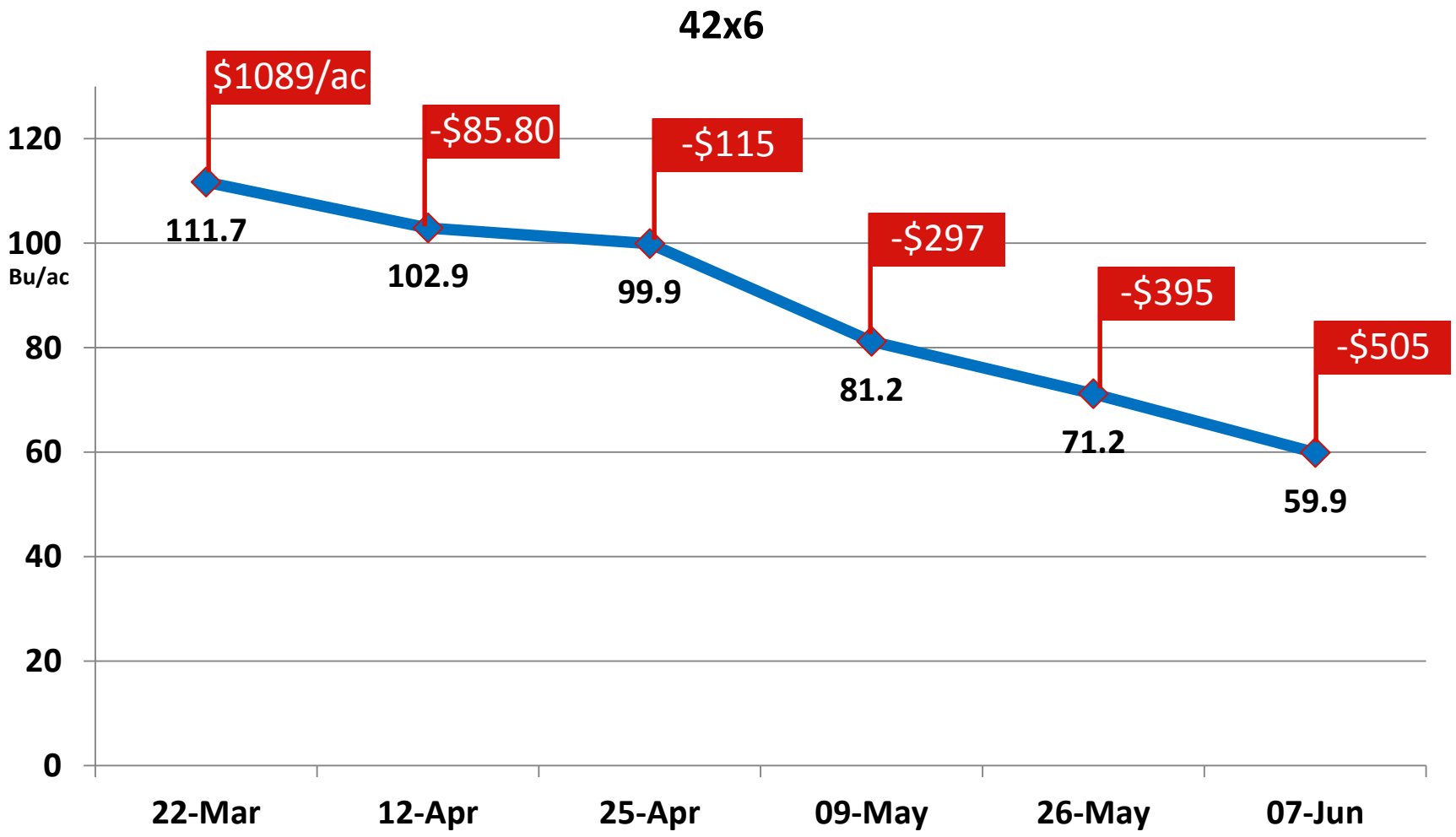
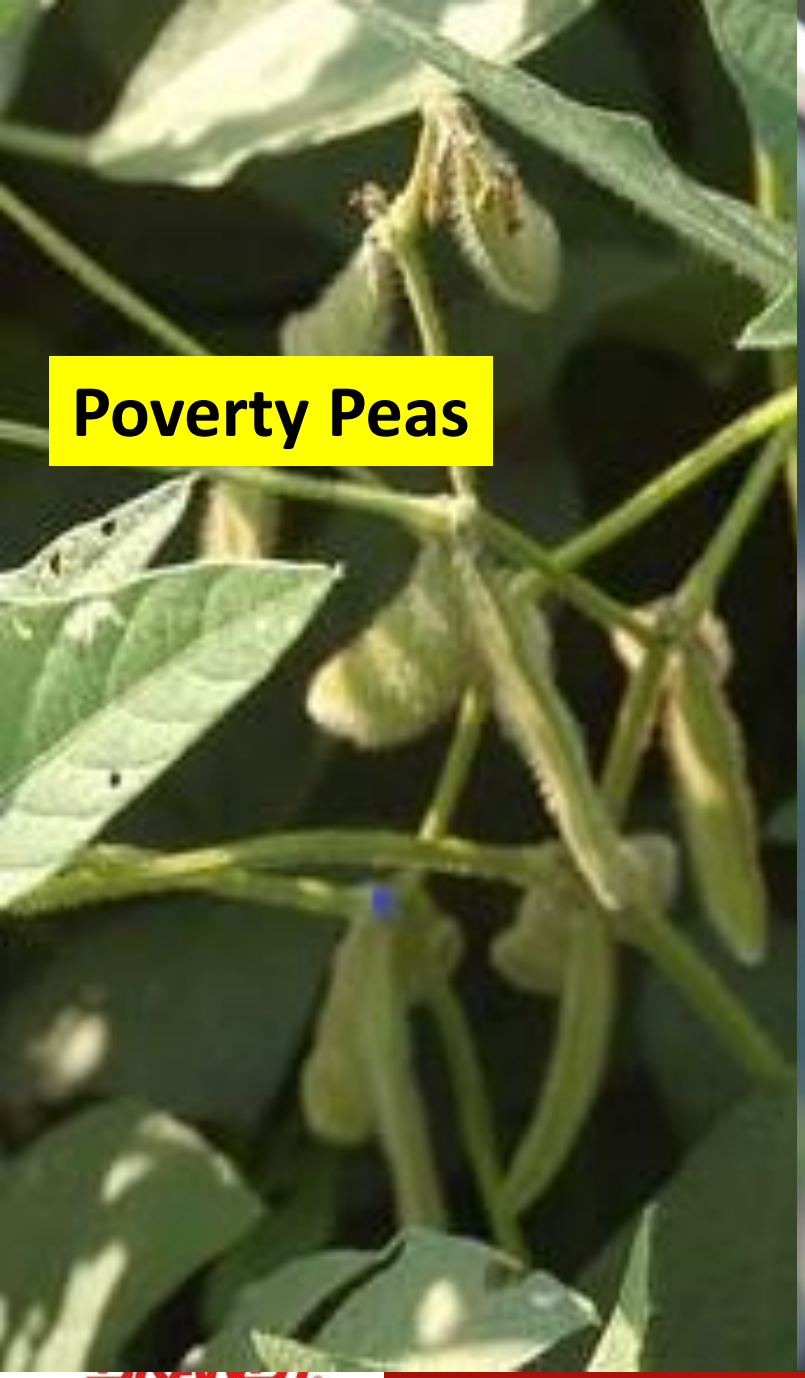
26-Apr
3-May
10-May
17-May
24-May

Soybean Planting Date Trials -2017



Green Stem Syndrome-INSECTS


Poverty Peas


Prairie Pearls

Grower Insights

2018 Soybean Grower Insights to Increasing Yields

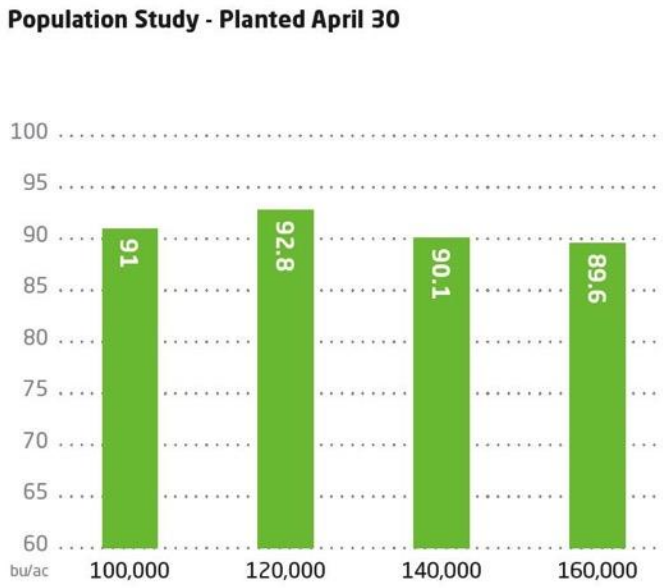
Soybeans throughout central Illinois were really good in 2018. We witnessed more growers hit 100+ bu/ac than ever before and overall averages for our trade area were among the best in the country, again. We will do our job on the research farms to continue to push the genetics as far as we possibly can.

- Sulfur at planting on soybeans creates bigger root nodules = more yield
- Foliar applications of BRANDT Smart B-Mo makes nitrogen “behave” in the plant
- Plant early with a seed treatment to maximize yield and profit
- Lower populations provided better yields and improved standability
- The number one management to consider is fungicide, BRANDT Smart B-Mo and insecticide at R4

Population Study

The population trial at our Lexington location was designed to identify the ideal planting population for early planted soybeans. Factors to consider when changing the population are planting date, management, fertility, soil and row width.

- A population that is too high will have issues with nutrient availability and late season standability
- A population that is too low will not achieve maximum yield
- Consider a higher population as the planting window closes
- It is essential that seed treatments are used with lower populations and early planting dates



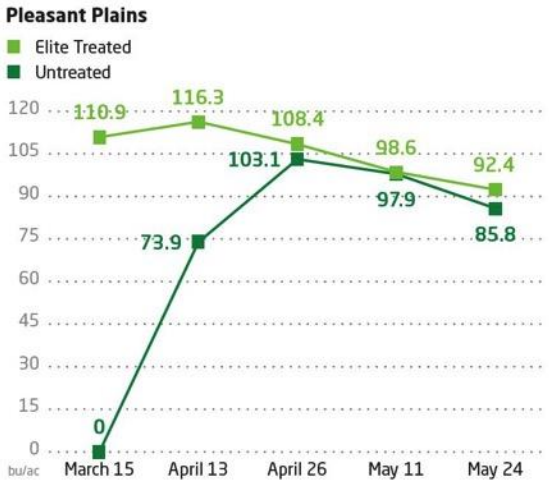
Use field data, variety selection and planting date to determine the correct population for your fields. Keep in mind that populations will vary from field to field.

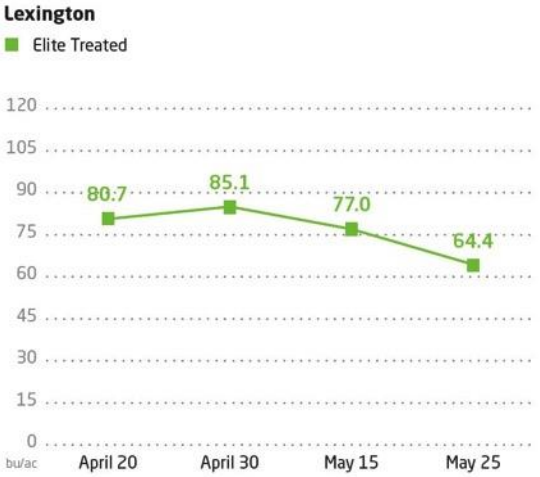
Planting Date

The 2018 soybean planting date trial confirmed that early planting will yield higher than later planting. This year we added an additional variable to the trial by having a treated and untreated seed at each planting date. This trial proves the importance of soybean seed treatments.

- For the 4th consecutive year, earlier planted soybeans were the yield winners
- The comparison of treated vs untreated soybeans demonstrates the importance of treatment technologies protecting yield at early planting date
- Seed variety selection and treatment rank among the highest ROI in soybean production
- Early planting typically means a longer reproductive period

Data from both Pleasant Plains and Lexington, IL confirm the trend we have seen for consecutive years. Early planted soybeans have a greater chance to achieve higher yields.



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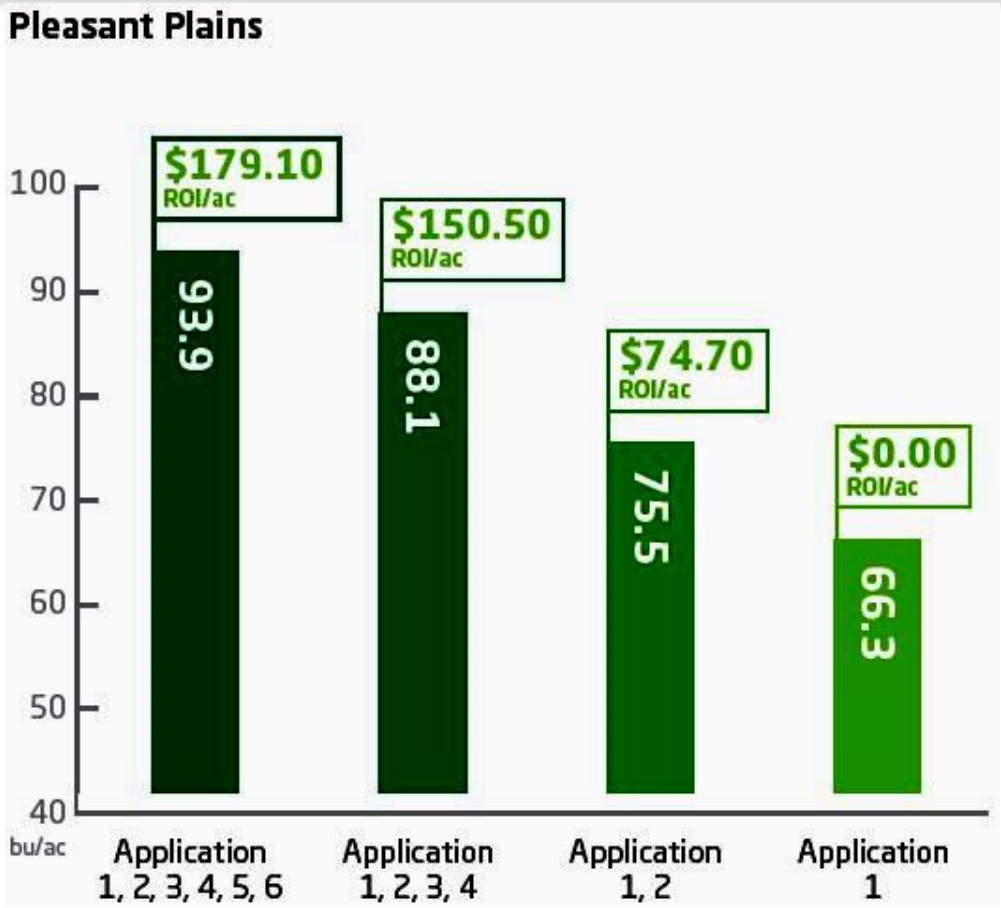
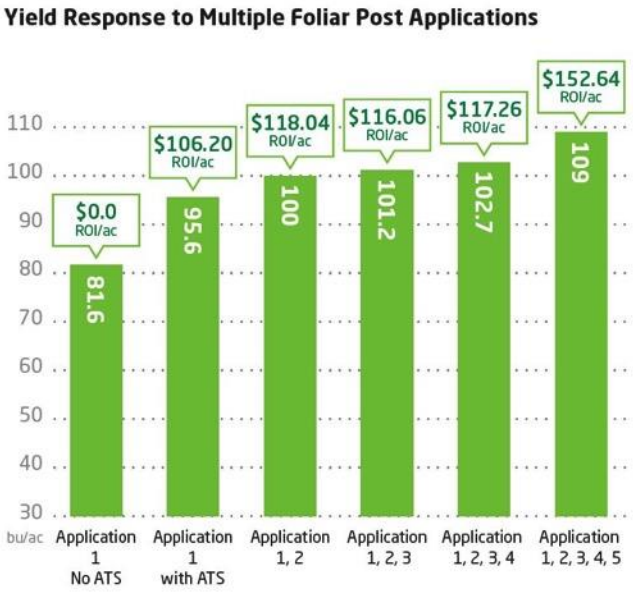
NEBRASKA - IOWA SUPPLY COMPANY
Lubricants

Soybean Post Application Trips





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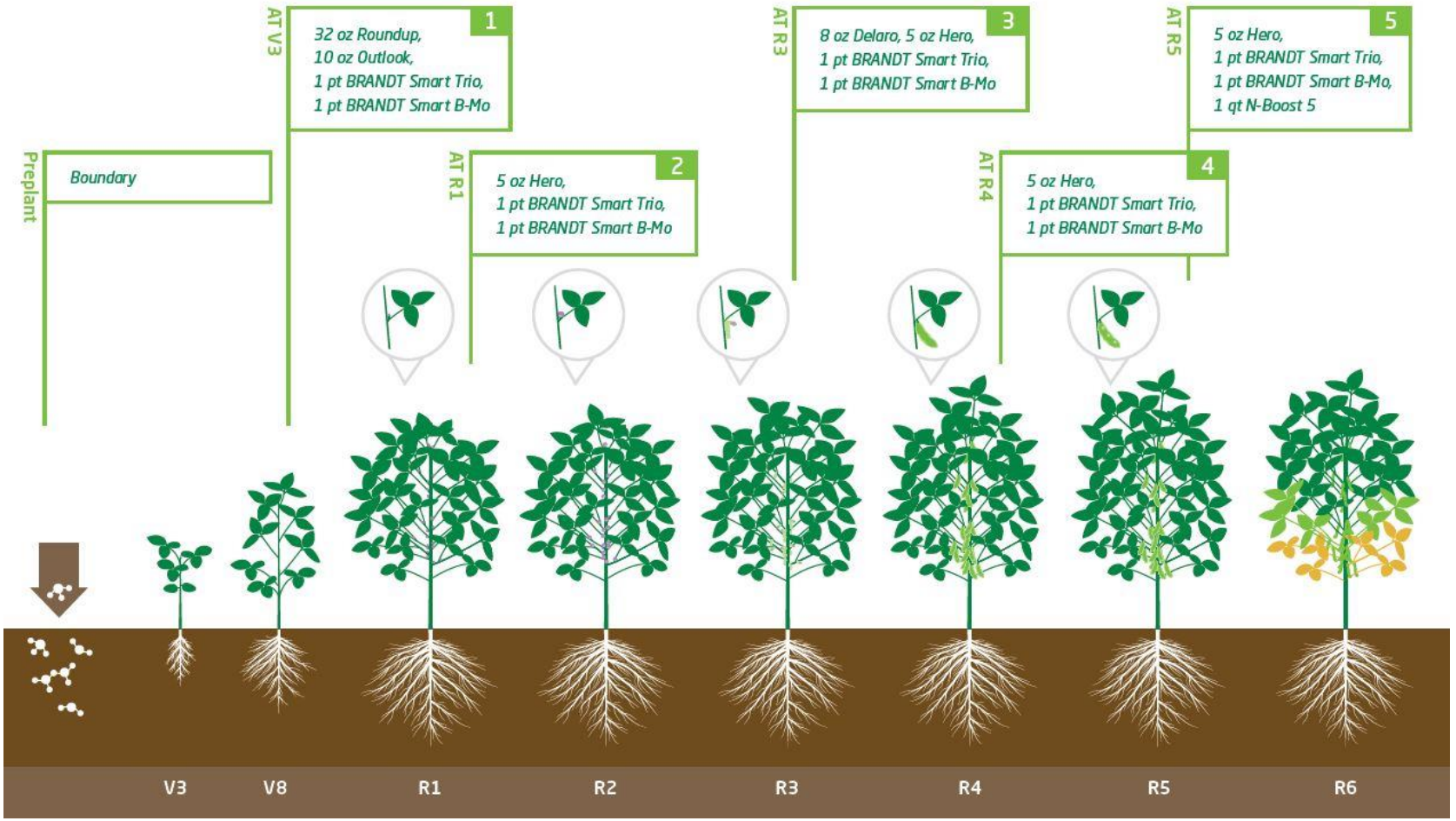

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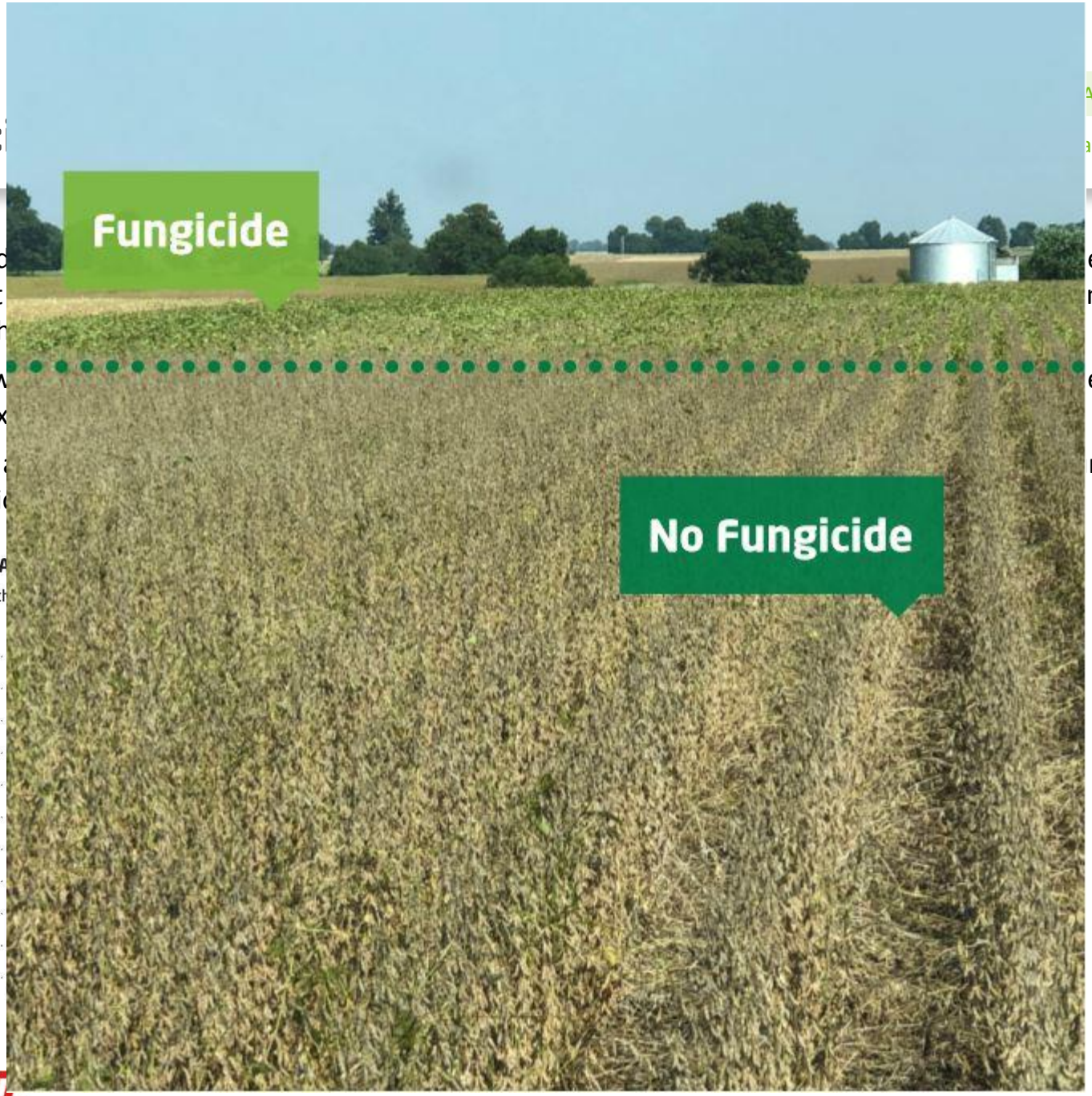

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Foliar Iron – Effects on Cercospora Leaf Blight

- Effects of Iron on Cercospora Leaf Blight of Soybeans

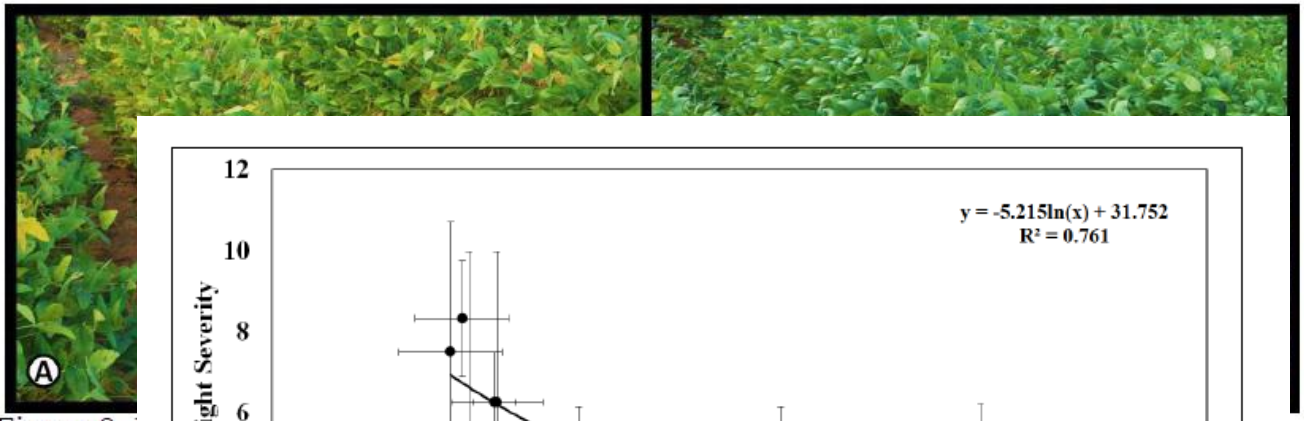

Figure 8.
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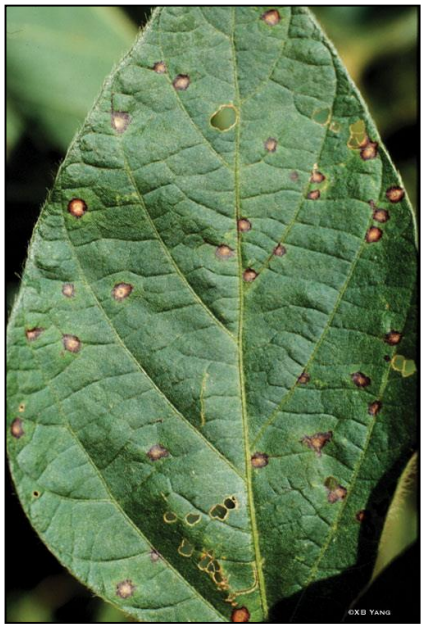
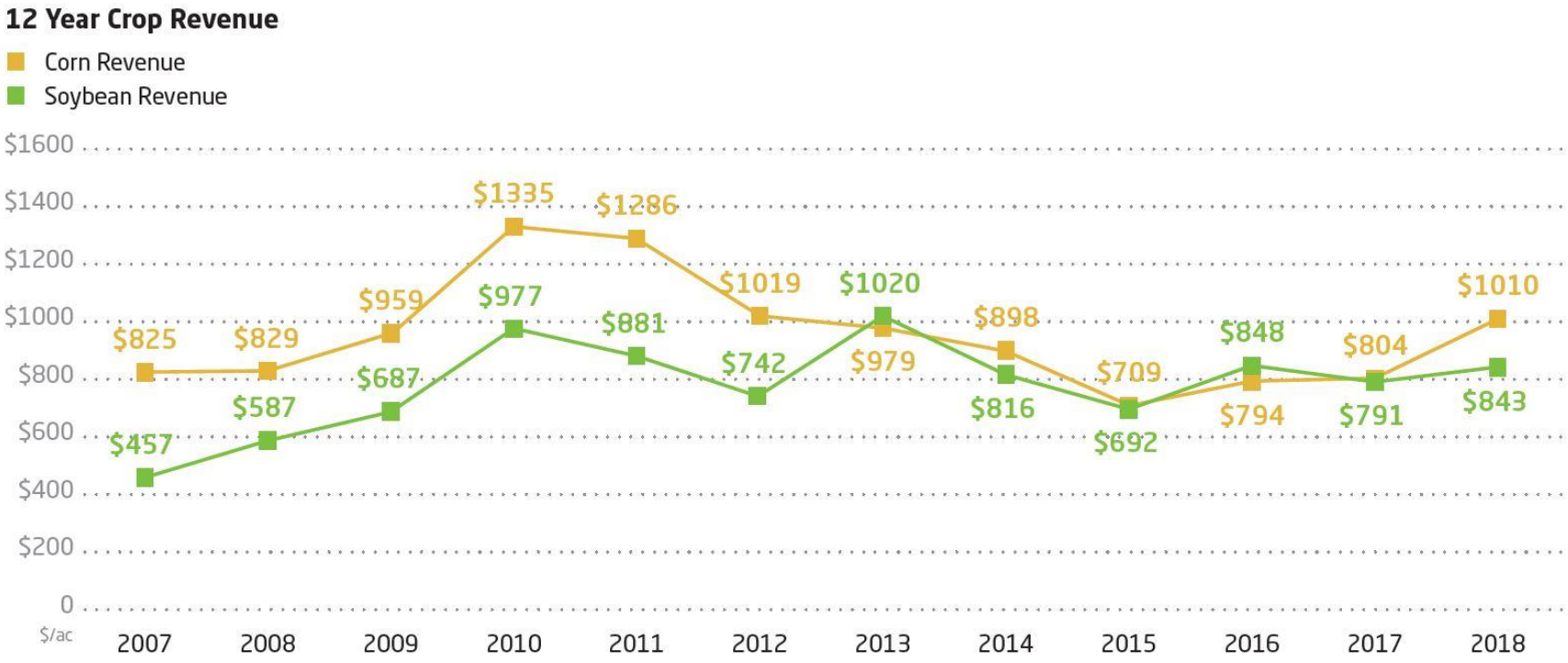
Figure 7. Relationship between severity of blight leaf symptoms (percentage of leaf area affected), and iron concentration in leaves (mg/kg dry matter). Bars indicate standard error between four replications.



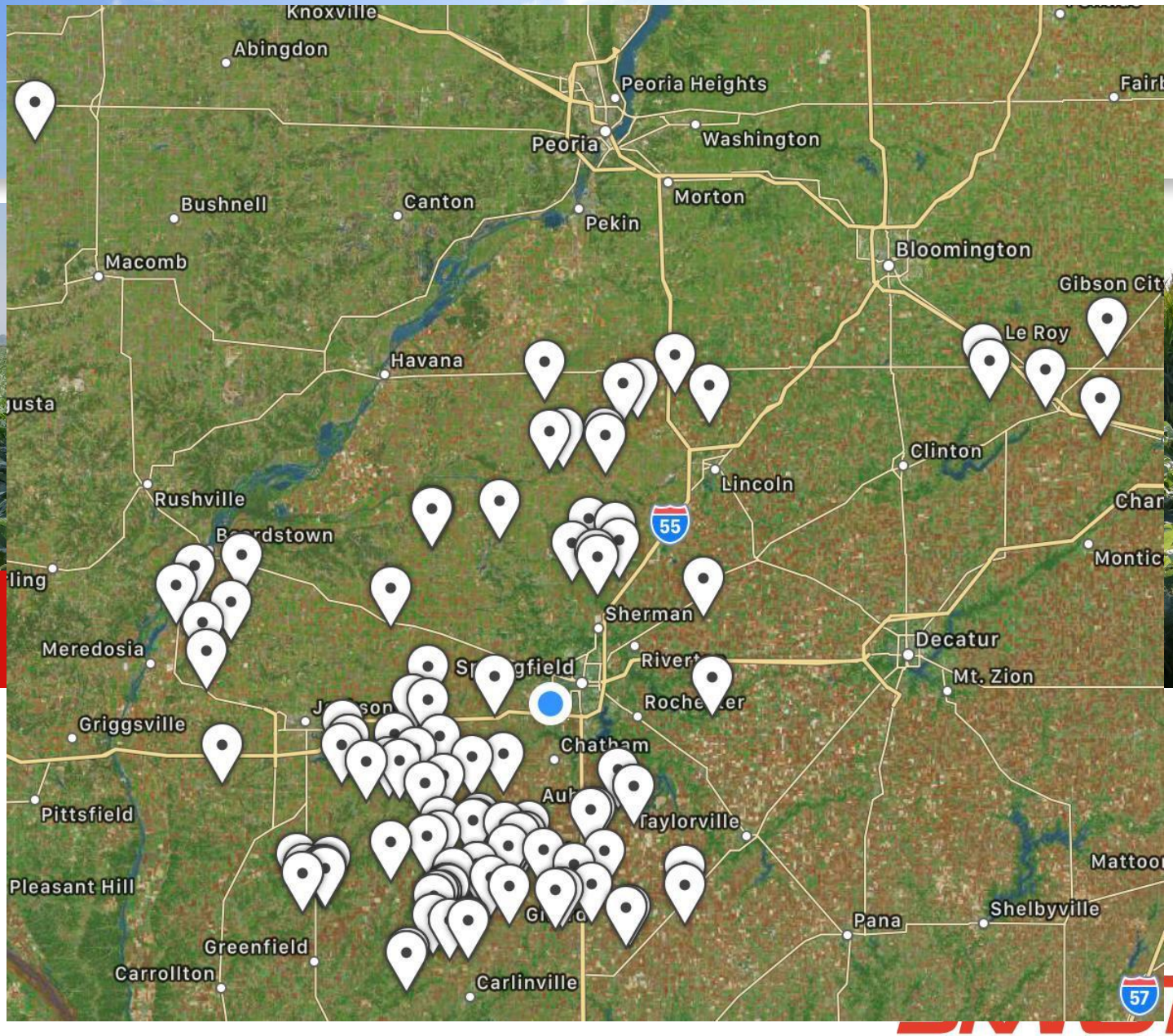
2007-2018 Yield and Revenue

The number one contributing factor for increased revenue in 2018 was great yields. The prices used to calculate revenue were $3.68/bu for corn (+$.19/bu vs 2017) and $8.60/bu for soybeans (-$1.15/bu vs 2017). Good weather, product selection and placement, and proper management of each acre gives growers the best chance for increased profitability at harvest.



2018 On Farm High Yield Programs

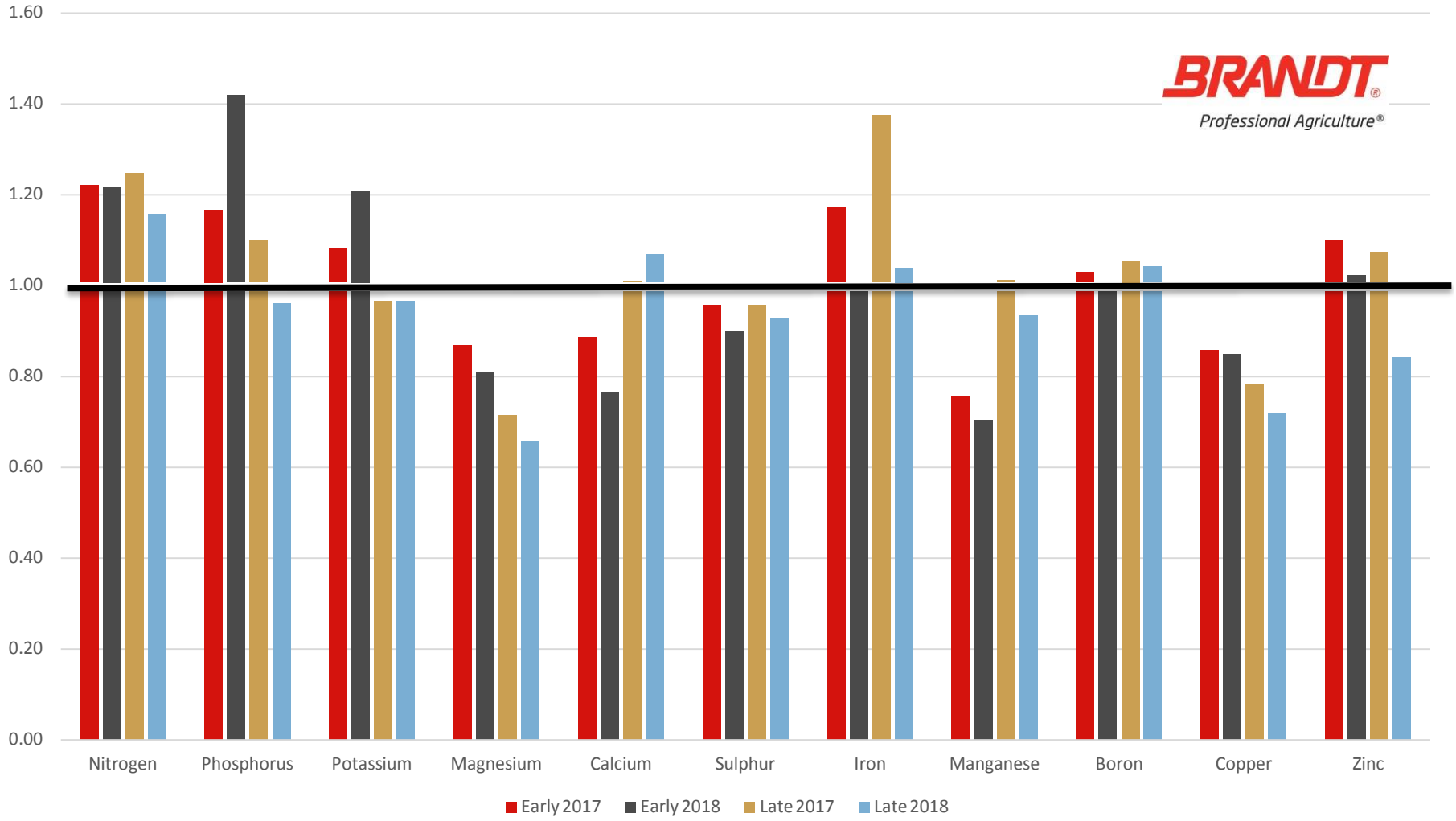
BRANDT®
Professional Agriculture®



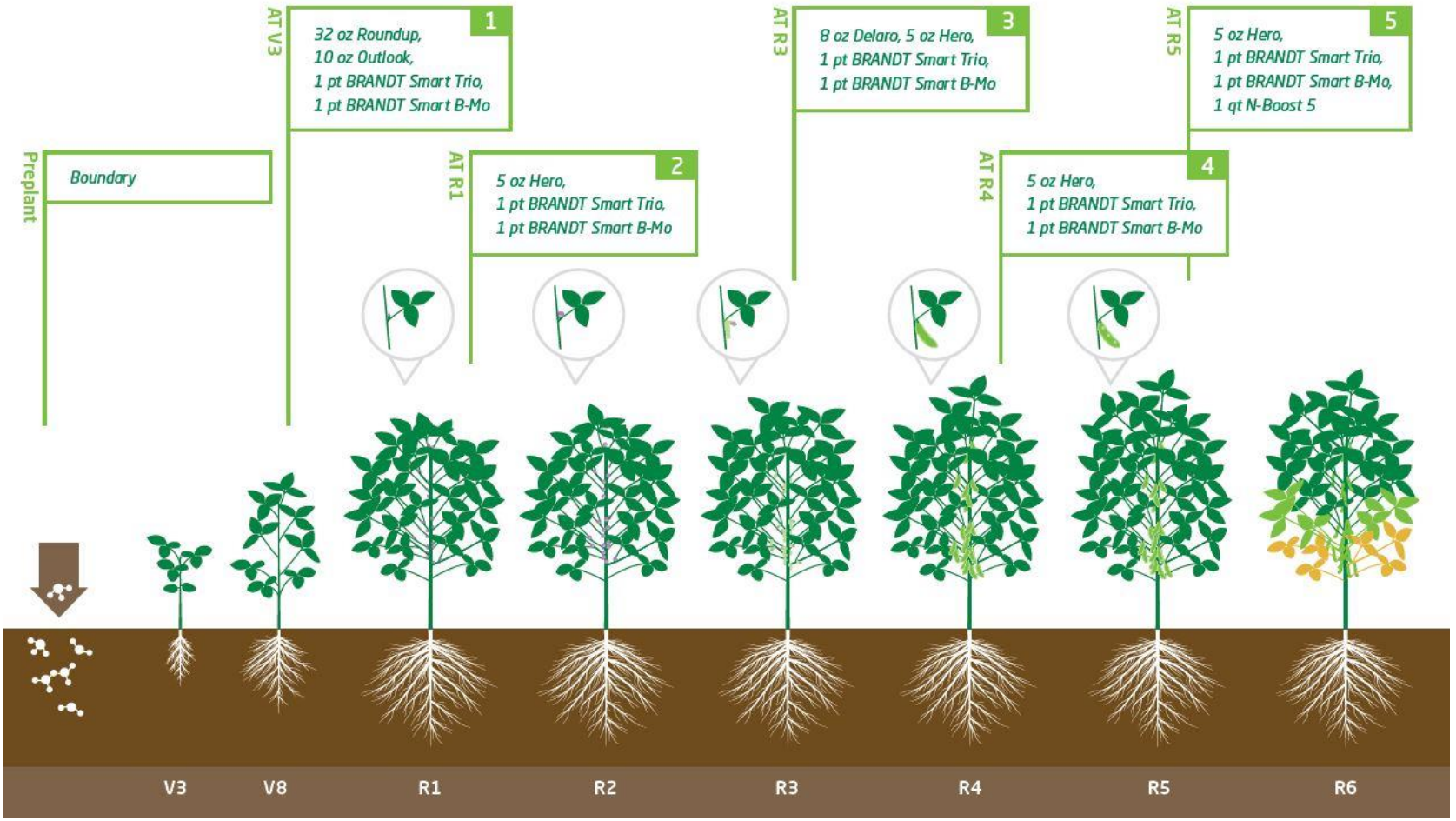
BRANDT®

Professional Agriculture®

Brandt High Yield Tissue Tests



Soybean Post Application Trips



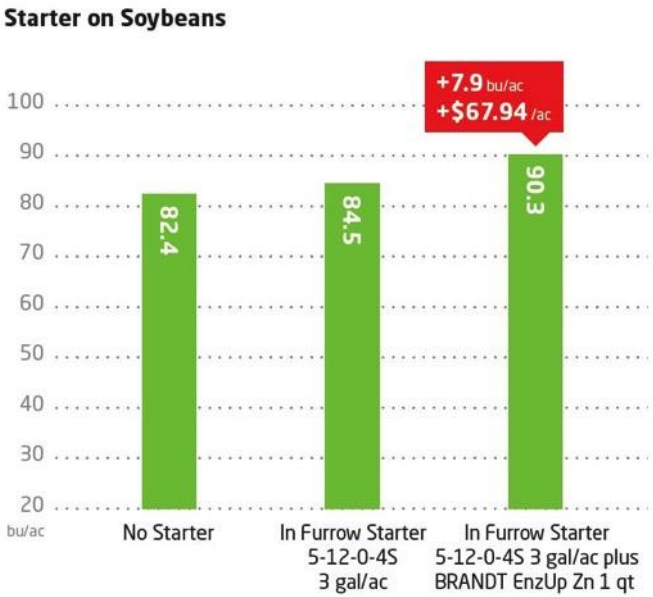
At Plant – Key Products

Product	Type	Rate
EnzUp Zn	Enzymes – Nutrient uptake enhancer	1 qt/acre

Starter on Soybeans

Soybean management has increased to boost yields and profitability. One area we have seen sizable yield increases is in early season nutrition.

- BRANDT EnzUp is a patented enzyme technology that increases nutrient availability and uptake
- Early nutrition sets the foundation for plant health and late season yield



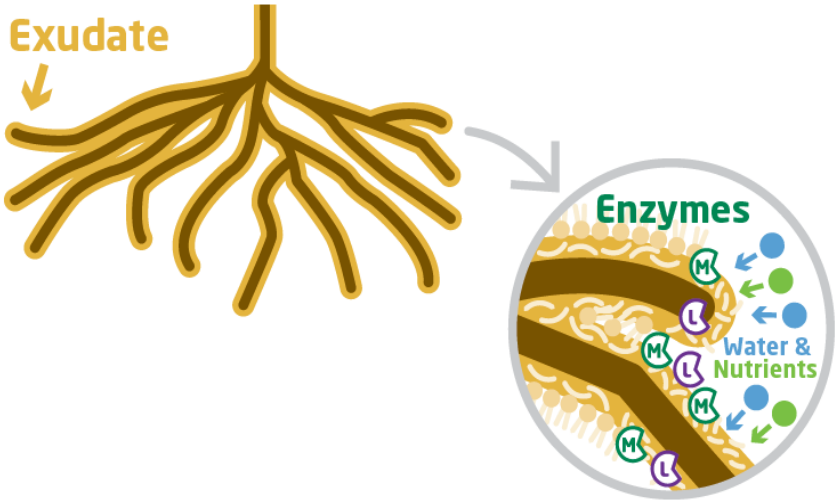
There are several viable fertilizer solutions that benefit plant yield in soybean production. Early nutrition is an important part of a high yield soybean program.

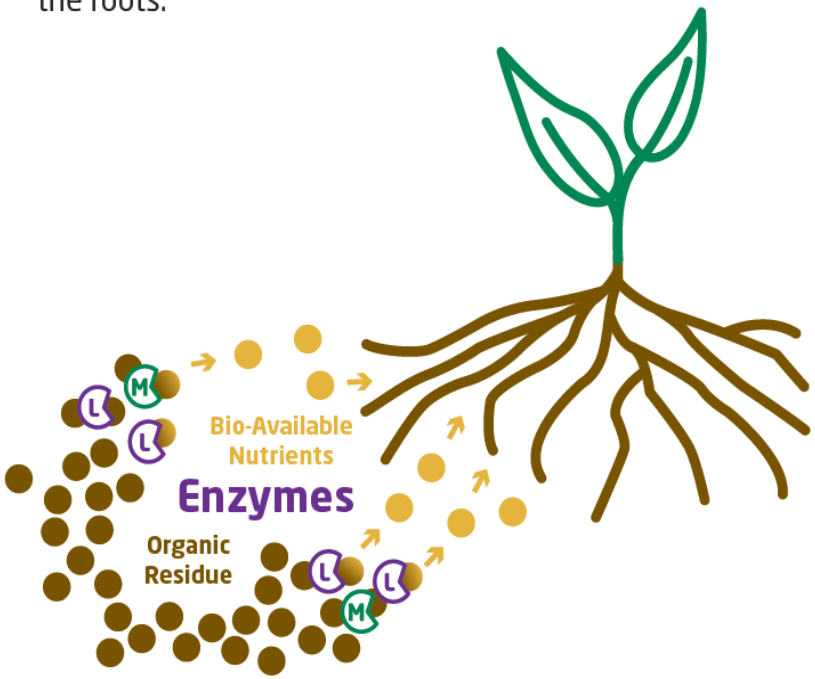
Product Spotlight: BRANDT EnzUp Zn

Contains a High Concentration of Mannanase and Lipase Enzymes That Boost Nutrient Availability and Uptake

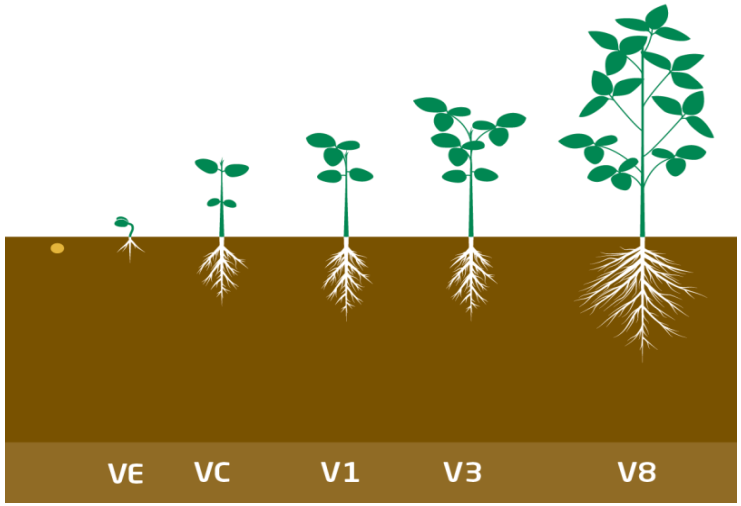
Mannanase enzyme - its primary function is to break down starches in the exudate that surrounds the outermost layer of the root tips. This chemical reaction creates a draw of water and nutrients to the root zone and releases sugars to the plant. This in turn boosts root growth and increases microbial activity.

Lipase enzyme – its primary function is to break down lipids in root exudates and organic residue in the soil allowing for better water flow and nutrient uptake by the roots.





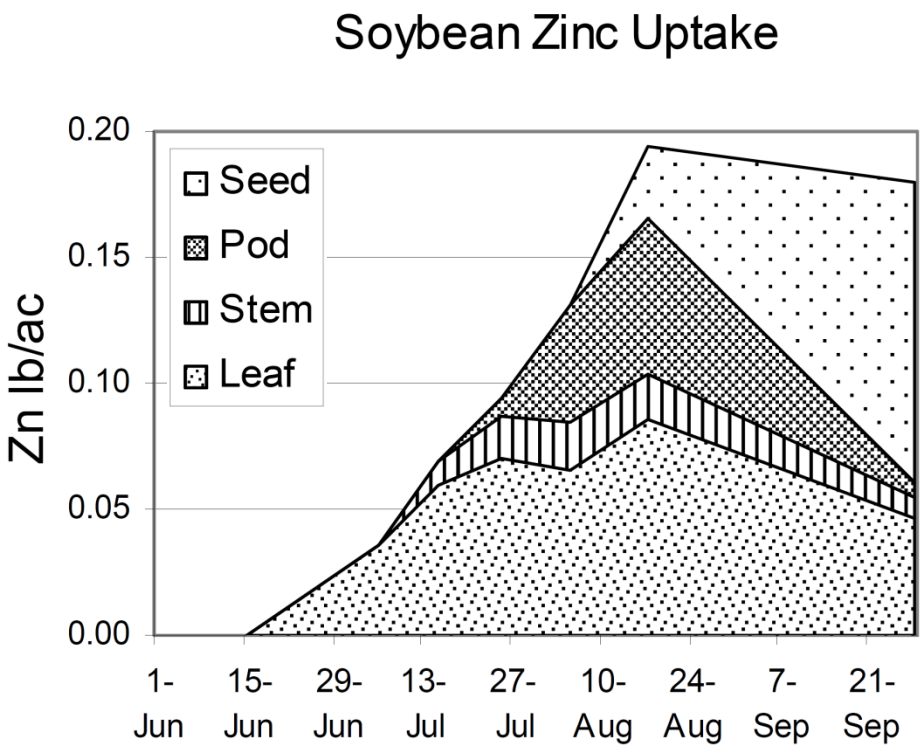
Foliar – V Stages – Zn, Mn and B key micronutrients



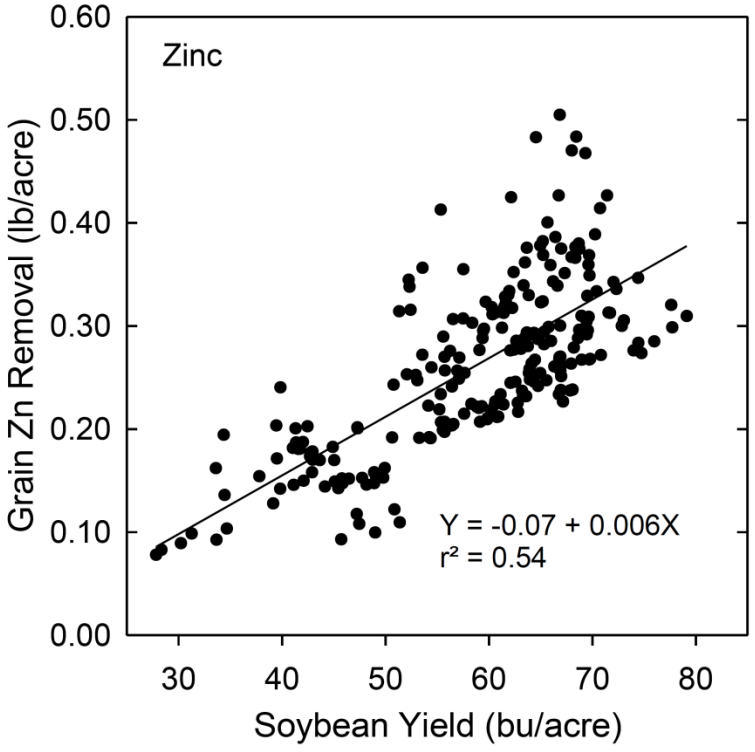
Product	Type	Rate
Brandt Smart Trio / Brandt Smart Quatro	Micronutrient Zn + Mn + S	1 qt/acre
Brandt Smart B Mo	Micronutrient B + Mo	1 pt/acre

Zinc Utilization in Soybeans

- Over 50% of total Zn utilization occurs during seed development, a good portion is translocated from the pod and leaf.



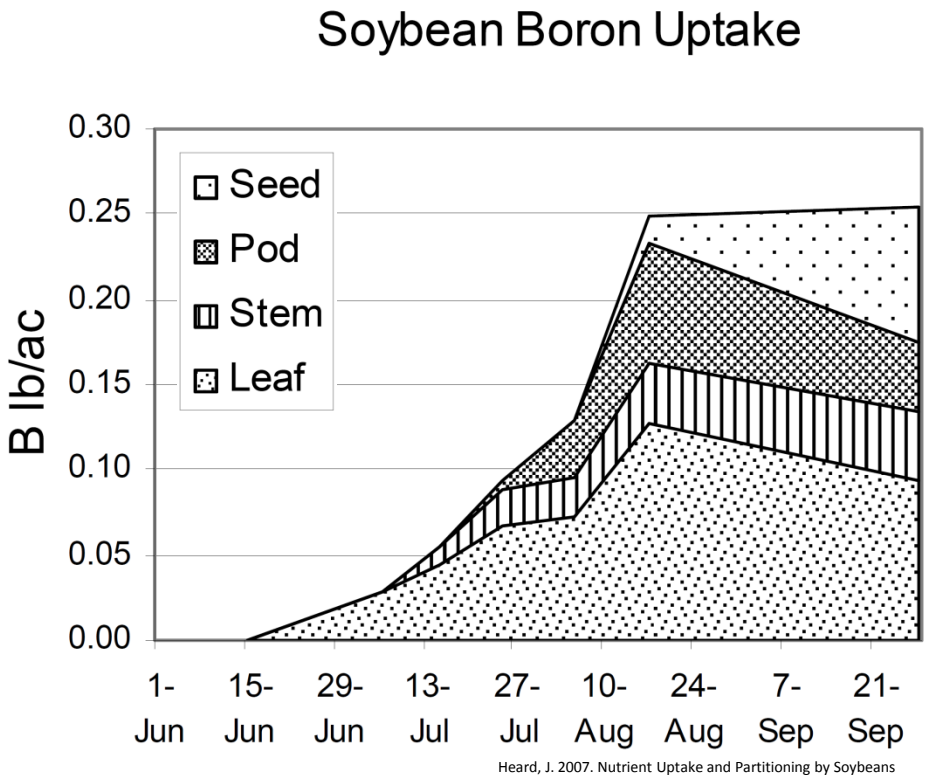
Heard, J. 2007. Nutrient Uptake and Partitioning by Soybeans



Mallarino, J., Iowa State University, 2011. Nutrient Uptake by corn and soybeans, removal and recycling with crop residue

Boron Utilization in Soybeans

- The demand for boron shows very clear peaks in the key growth stages and reproductive stages.



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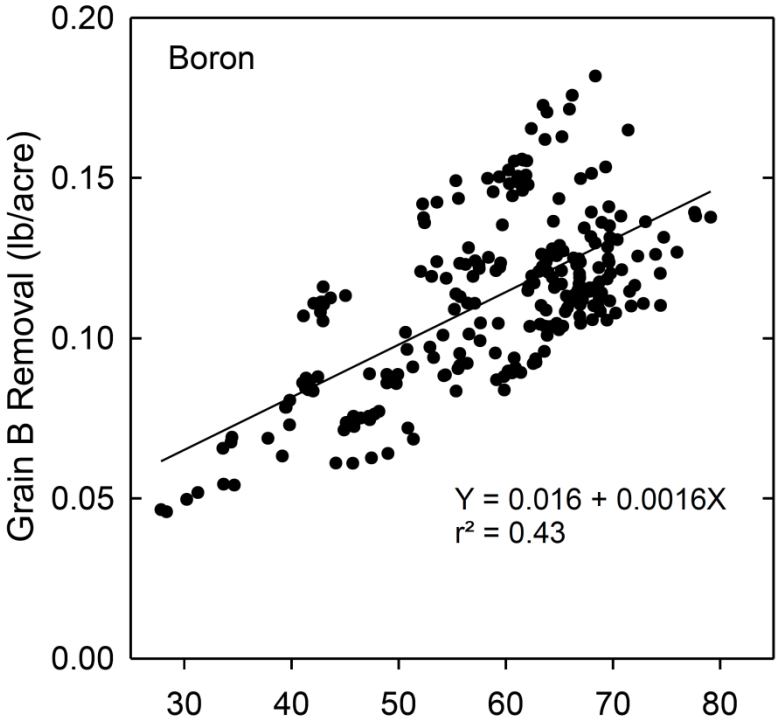


Mallarino, J., Iowa State University, 2011. Nutrient Uptake by corn and soybeans, removal and recycling with crop residue

BRANDT

The Effect of Stress on Vegetative Soybeans

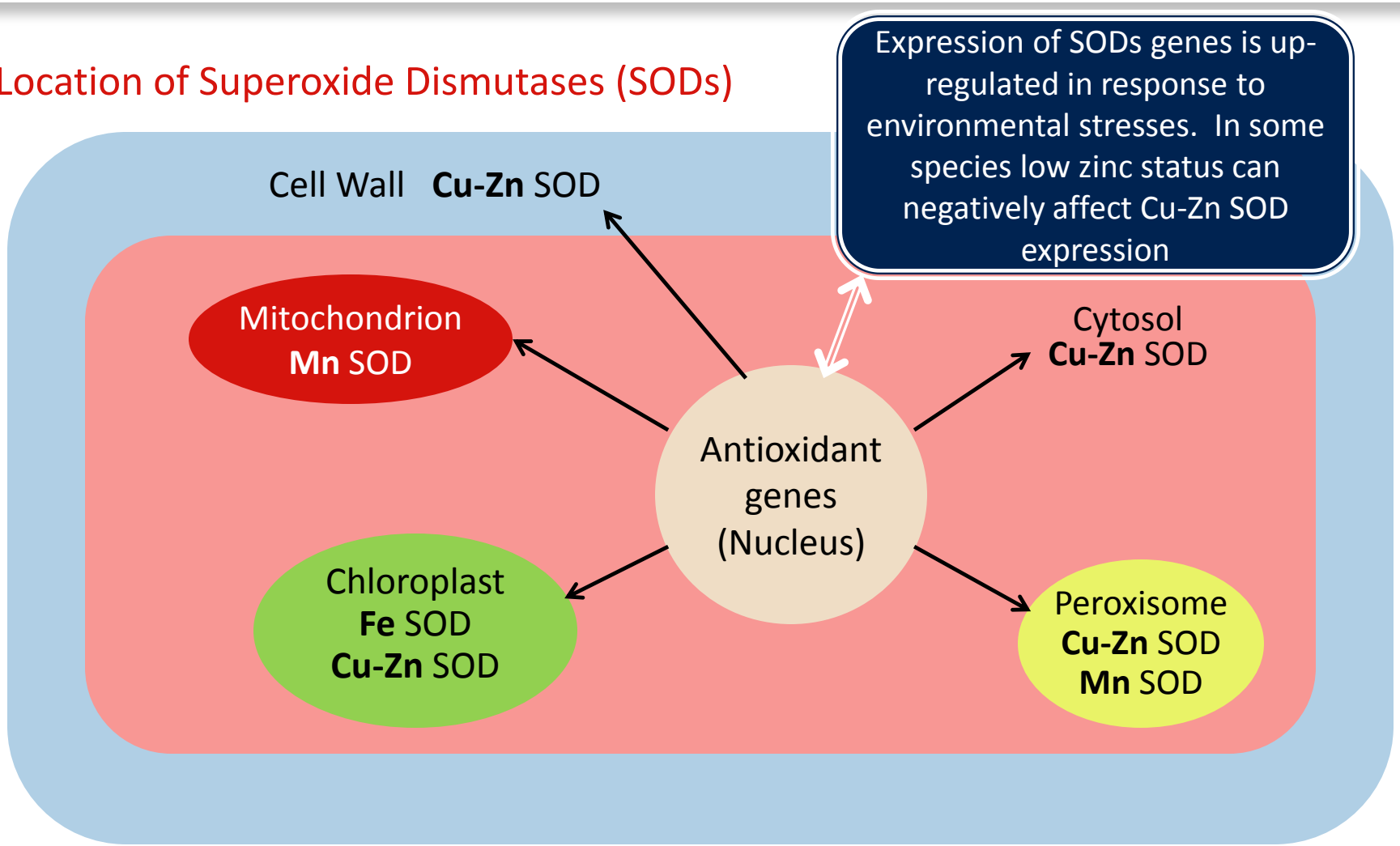
- Effects of Stress at Vegetative Stage
  - Growth on soybean during drought is diminished.
  - Root growth increase as plant carbohydrates are shifted downward to roots.

- Effects on Soybeans during grain fill
  - Flower and pod abortion
  - Drought can reduce pod # by 20% as a result of flower and pod
  - Early maturity and shortening of grain fill periods
  - Nodule health can be affected by lack of carbohydrate supply

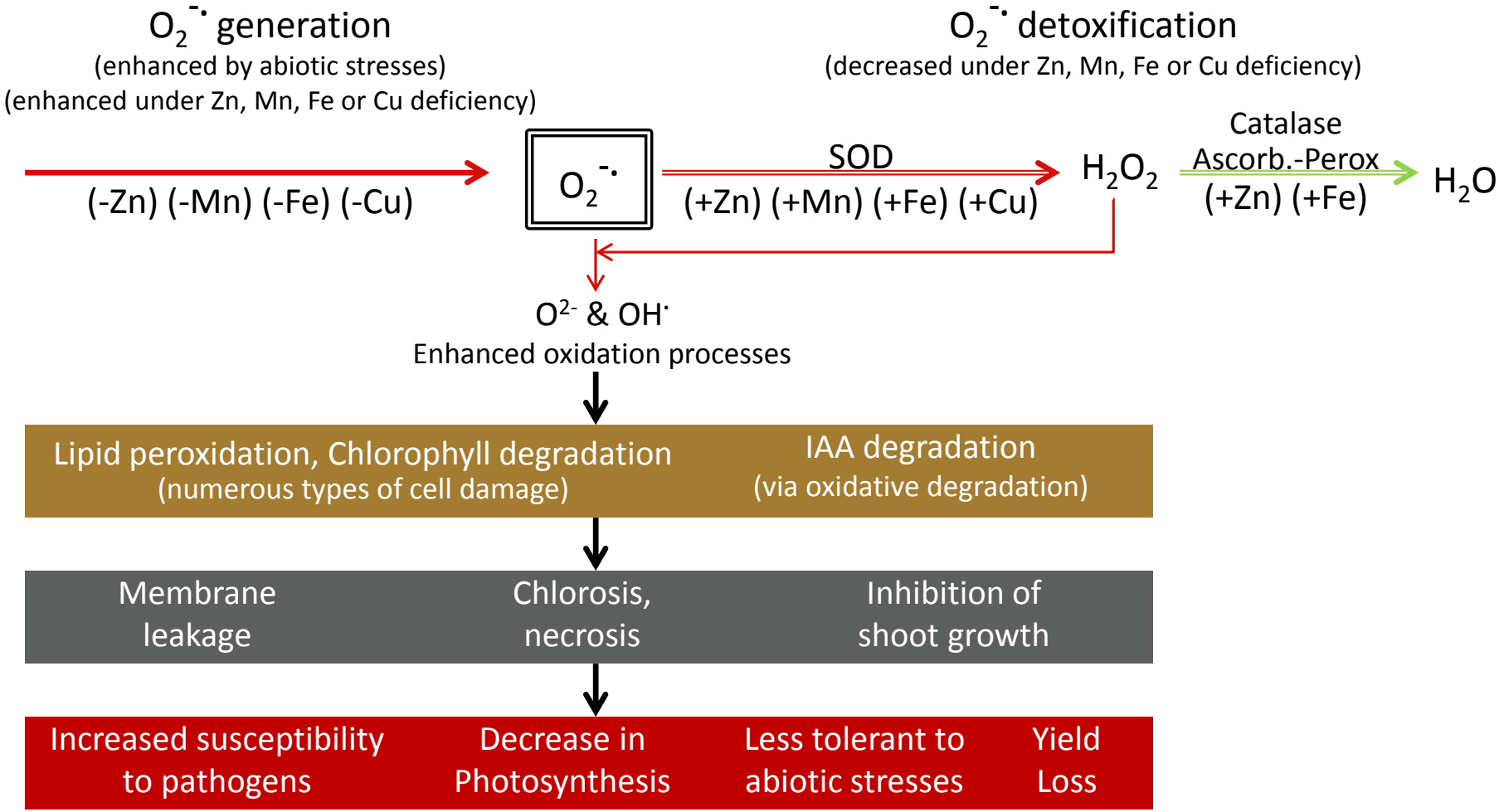
Figure 1. B-deficient soybean pods, Slaton, U. of Arkansas, 2003.

Role of Micronutrients in Plant Health
Superoxide Dismutase (SOD) - Metalloenzymes

Location of Superoxide Dismutases (SODs)



Role of Micronutrients in Plant Health
Superoxide Dismutase (SOD)



Cakmak and Marschneer, 1988a, b and Cakmak, *et al.,*1989

Table 4. Interaction effect of water stress and foliar application in yield physiological traits and seed vigor of two soybean cultivars

Stress level	Foliar application levels	Superoxide dismutase	Peroxidase	Catalase	Chlorophyll *a*	Chlorophyll *b*	Chlorophyll *a* + *b*
	F_0	3.62 b	3.32 a	136 a	1.38 b	0.68 b	2.10 b
I_1	F_1	3.63 b	3.23 a	136 a	1.35 b	0.69 b	2.05 b
	F_2	6.30 a ↑	2.90 b ↓	124 b ↓	1.51 a ↑	0.81 a ↑	2.32 a ↑
	F_0	6.55 b	7.34 a	185 a	0.71 b	0.25 b	0.96 b
I_2	F_1	6.56 b	7.35 a	182 a	0.69 b	0.25 b	0.93 b
	F_2	8.05 a ↑	4.33 b ↓	150 b ↓	0.86 a ↑	0.43 a ↑	1.30 a ↑
	F_0	6.44 b	6.72 a	200 a	0.89 b	0.38 b	1.27 b
I_3	F_1	6.37 b	6.70 a	198 a	0.89 b	0.37 b	1.26 b
	F_2	8.14 a ↑	3.68 b ↓	170 b ↓	1.24 a ↑	0.59 a ↑	1.83 a ↑

Stress level	Foliar application levels	Proline	Soluble carbohydrates	fv/fm	Rate of germination	Grain yield
	F_0	3.68 a	16529 a	0.529 b	21.31 b	3106 b
I_1	F_1	3.41 a	16416 a	0.530 b	21.38 b	2989 b
	F_2	2.77 b ↓	14945 b ↓	0.540 a	23.62 a	3644 a ↑
	F_0	67.12 a	23176 a	0.389 b	19.86 b	2295 b
I_2	F_1	66.12 a	23066 a	0.388 b	19.85 b	2325 b
	F_2	6.94 b ↓	17597 b ↓	0.430 a	22.44 a	3215 a ↑
	F_0	62.31 a	22922 a	0.452 b	14.49 b	2011 b
I_3	F_1	61.85 a	22824 a	0.460 b	14.94 b	2030 b
	F_2	6.17 b ↓	17283 b ↓	0.509 a	20.44 a	3082 a ↑

At each stress level, surface treatments with the same letters are shown, with no significant difference.

- I_1 = control / well watered / not stressed
- I_2 = stressed by skipping irrigation (V_5 to R_1)
- I_3 = stressed by skipping irrigation (R_1 to R_3)

- F_0 = no foliar application
- F_1 = foliar application of distilled water
- F_2 = foliar application of zinc sulfate

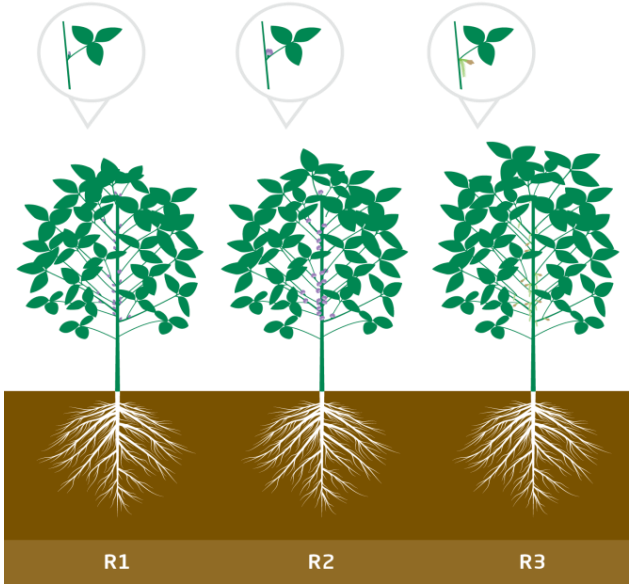
BRANDT

Herbicide Stress
1 day after application(Roundup plus Resource plus Smart Trio)

Herbicide Stress
3 days after app. (Roundup+Resource plus Smart Trio)

Herbicide Stress
10 days later

Foliar – R Stages - PGRs and Biostimulants



Product	Type	Rate
N-Boost 5	Nitrogen Metabolism & Usage at Cellular Level	1 to 2 qts/acre
Ascend SL	Cytokinin, Gibberillic Acid, Auxin	3.4 fl oz/acre split: V3 to V5 and R1 to R3 6.7 fl oz/acre between between R1 to R3

Ascend® SLOverview

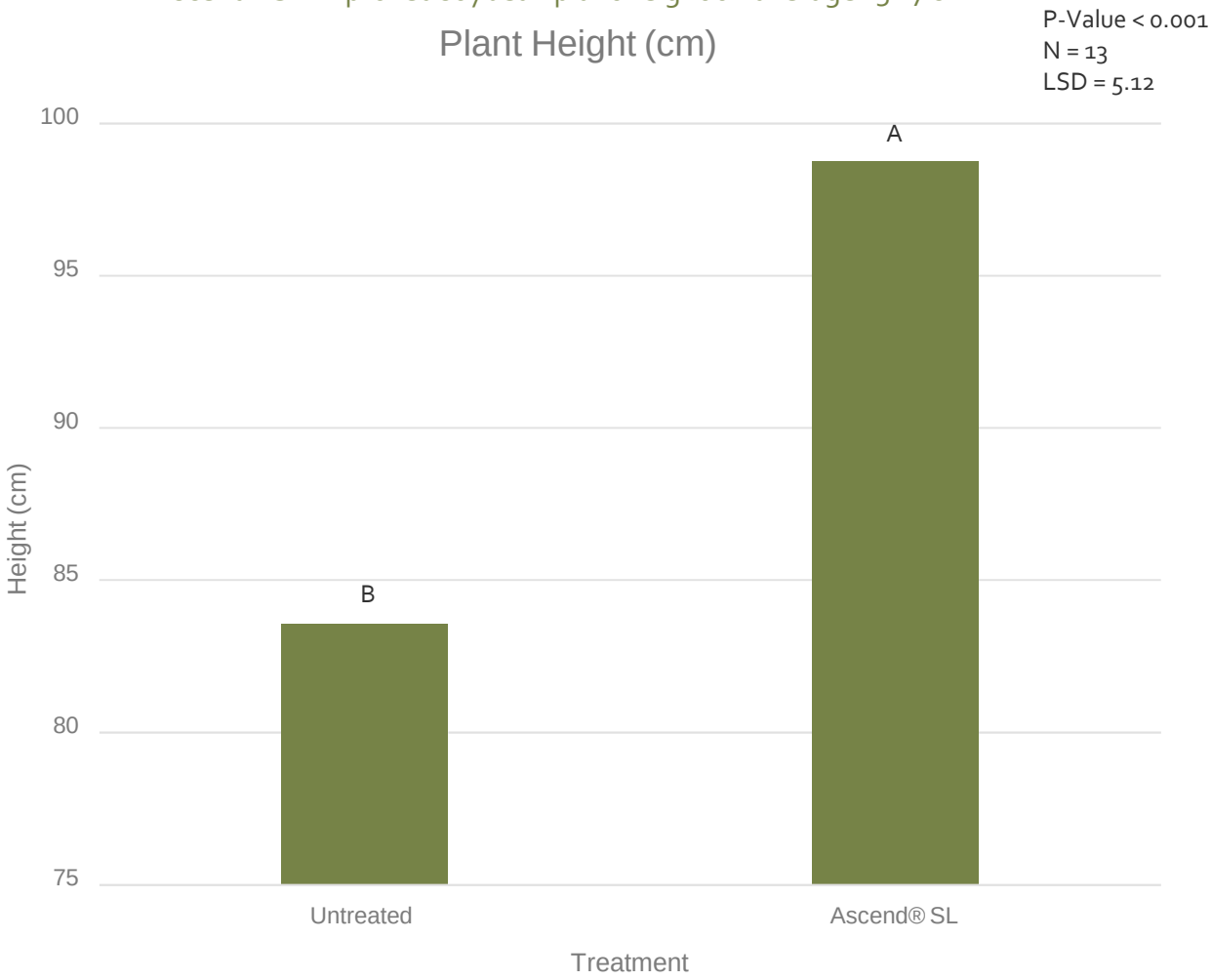
- Ascend® SL is an EPA registered Plant Growth Regulator

- Comprised of 3 main plant hormones
  - Cytokinin
  - Gibberellic Acid
  - Auxin

- Label use recommendations for soybeans
  - Foliar application between 3rd and 5th trifoliate leaf followed with an application between R1 and R3 both at a 3.4 fl oz/A rate
  - OR –
  - Foliar application between R1 and R3 at a 6.7 fl oz/A rate

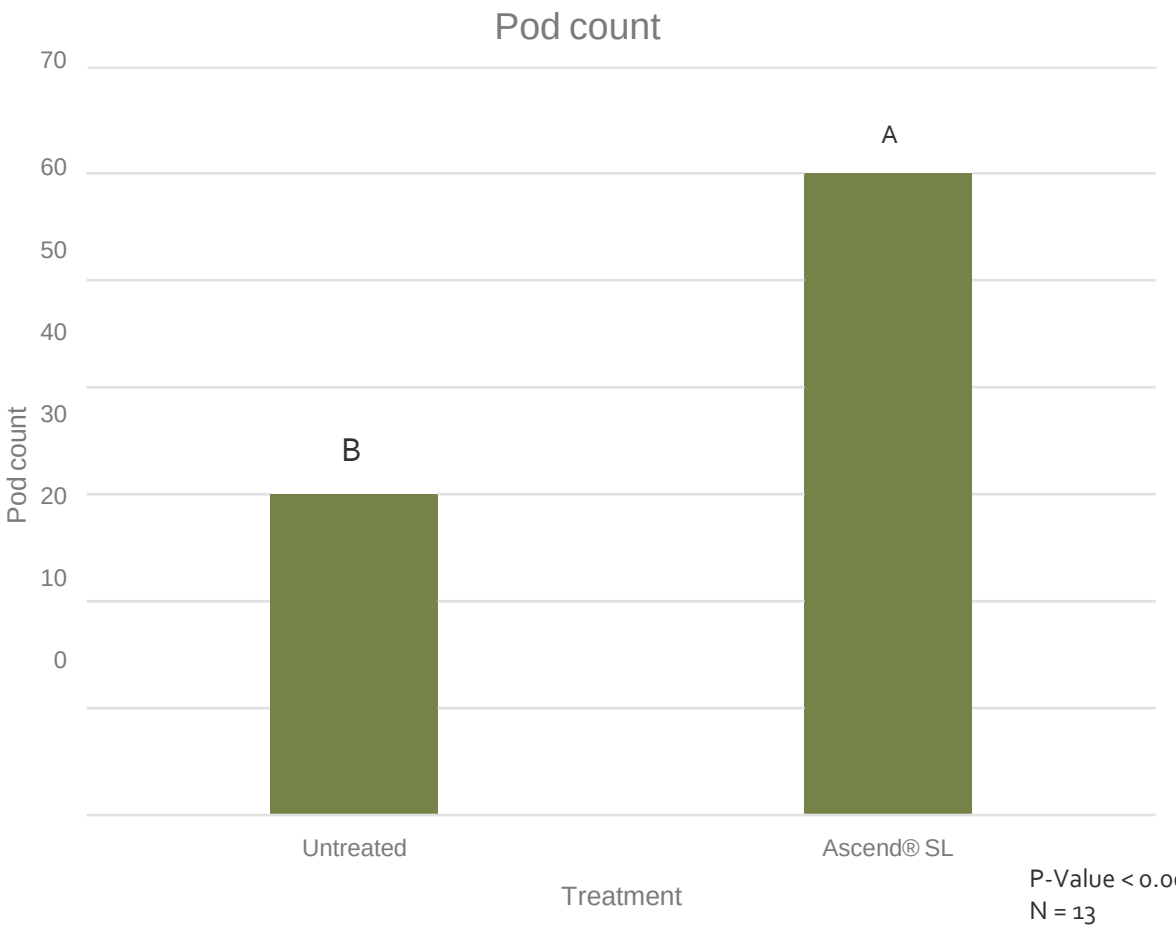
Data Insights

Ascend® SL improved soybean plant height on average 15.17 cm



Data Insights

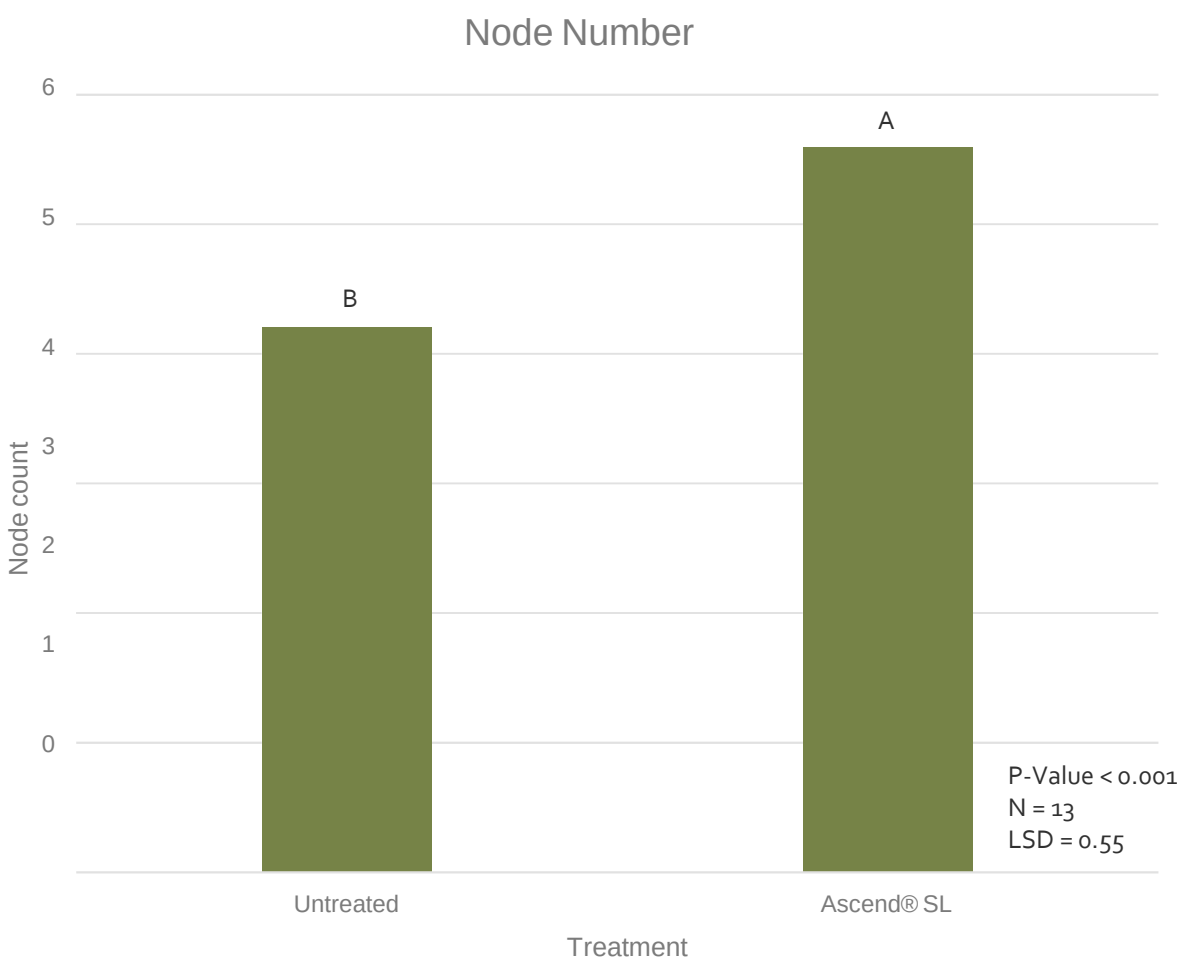
On average, Ascend® SL improved soybean pod count by 29.89



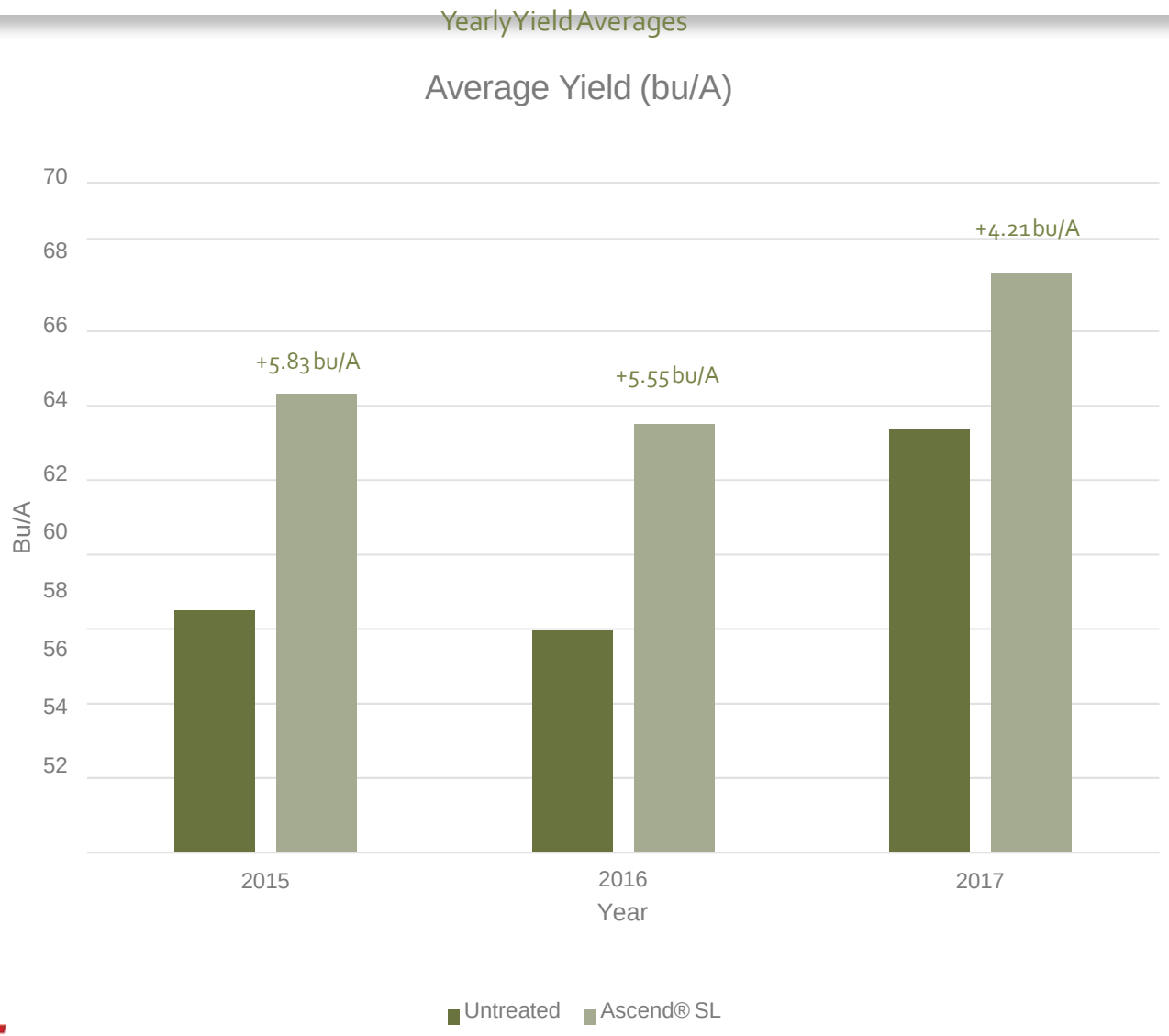
P-Value < 0.001
N = 13
LSD = 11.35

Data Insights

On average, Ascend® SL increased soybean nodes by 1.38



Data Insights



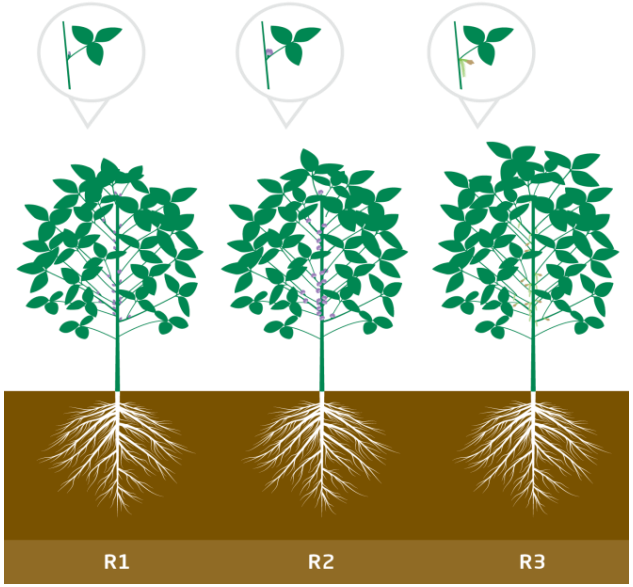
WINFIELD UNITED

Summary

- A foliar application of Ascend® SL provided yield increases to soybeans in on-farm trials
- Ascend® SL provided multiple agronomic benefits
  - Increased stem diameter
  - Taller plant height
  - Greater number of nodes
  - More pods per plant
- Over the three years of testing, the average yield response was +5.2 bu/A

BRANDT®

Foliar – R Stages - PGRs and Biostimulants



Product	Type	Rate
N-Boost 5	Improves Nitrogen Metabolism at Cellular Level	1 to 2 qts/acre
Ascend SL	Cytokinin, Gibberillic Acid, Auxin	3.4 fl oz/acre split: V3 to V5 and R1 to R3 6.7 fl oz/acre between between R1 to R3

N-Boost and the Role of Fermented Sugarcane Extract

N-Boost® 5

Foliar Nutrient Supplement

5-0-0

Guaranteed Analysis

Total Nitrogen (N)..... 5.0%
5.0% Urea Nitrogen

Derived from urea F2245

ALSO CONTAINS NONPLANT FOOD INGREDIENTS:

3% Fermentation extracts
(Derived from fermentation of sugarcane using mixed yeast and lactic acid bacteria culture is not a viable culture.)

General Information

N-BOOST 5 is recommended for use on field, row and vegetable crops listed below as part of a balanced fertility program.

Rate Recommendations

Root and Tuber Vegetables: (including potatoes, sugar beet, sweet potatoes, carrots, etc.): Apply 2-3 qt/A at tuber initiation and repeat 3 weeks later.

Leafy Vegetables: (including spinach, lettuce, *Brassica*): Apply 1-2 qt/A 2 weeks prior to first cut.

Bulb Vegetables: (including onions, garlic, leeks): Apply 1-2 qt/A at first true leaf and repeat 4 weeks later.

Cucurbit Vegetables: (including melons, squash, cucumbers): Apply 1-2 qt/A during vegetative growth and repeat as needed.

Fruiting Vegetables: (including tomatoes, peppers) and **Legume Vegetables:** (including peas, green beans, sweet peas): Apply 2-3 qt/A at first flowering and repeat 4 weeks later.

Corn and Soybeans: Apply 2-3 qt/A between V4 and V9.

Cereal Grain: (including rice, wheat): Apply 2-3 qt/A at end of tillering or at early stem extension.

Cotton: Apply 2-3 qt/A at first flowering and repeat 2 weeks later.

Pasture: (grass and legumes): Apply 1½-2 qt/A 3-5 days after each cutting and/or grazing.

Sugarcane: Apply 1½-2 qt/A at 20 inch cane height and repeat 30 days later.

Mixing and Handling Instructions

Put 1/3 to 2/3 of total desired water volume in tank. Add adjuvant(s) and pesticide(s) if desired and agitate until thoroughly mixed. Add desired amount of N-BOOST 5 and agitate until thoroughly mixed. Fill tank with remainder of desired water. A jar test is a good field practice for evaluating compatibility of multiple chemical mixtures.

Net Contents: 2.5 gal (9.46 L)
Density: 8.75 lb/gal @ 65°F
Net Weight: 21.6 lb (9.79 kg)
Packaged 2 x 2.5 gal (9.46 L)

49015DON100
2015-08 (GHS)

Information regarding the contents and levels of metals in this product is available on the Internet at http://www.aapfco.org/metals.htm
Information about the components of this lot of fertilizer may be obtained by writing to Donaghys Industries Ltd. and giving the lot number which is found on the label.

WARNING: Causes skin and eye irritation. May cause respiratory irritation.

Precautionary Statements: Wear protective gloves, protective clothing and eye/face protection. Use only in a well-ventilated area. Do not breathe mist/vapors. Wash thoroughly after handling. **First Aid:** *If in eyes:* Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical attention. Take off contaminated clothing and wash before reuse. *If on skin:* Wash with plenty of water. If skin irritation occurs, get medical attention. *If inhaled:* Remove person to fresh air and keep comfortable for breathing. Call a doctor if you feel unwell. **Storage and Disposal:** Do not contaminate water, food or feed by storage or disposal. Keep out of reach of children. Store container tightly closed in a cool/well ventilated place. Store locked up. Dispose of contents/container in accordance with local authority requirements.

CONDITIONS OF SALE: Acceptance and use of this product will be deemed to be acceptance of these conditions of sale. Results from the use of this product may be affected by factors beyond Donaghys control. These factors include but are not limited to mixing, use, time of application, weather, soil moisture, crop, crop life cycle and even though the product is fit for its stated purpose and label directions have been followed. Donaghys will replace any defective product free of charge, but to the extent permitted by law all other warranties representation conditions or obligations whether imposed or implied by law or otherwise, and the manufacturer's and supplier's liability for any indirect special or consequential losses or damages of any kind arising out of the supply and/or use of this product, including where it arises out of negligence, are expressly excluded. **In any event, to the extent permitted by law, the manufacturer's and supplier's liability arising out of the supply and use of this product is limited to the amount paid for the specific product.**

N-Boost is a registered trademark of Donaghys Industries Ltd.

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www.brandt.co 800 300 6559

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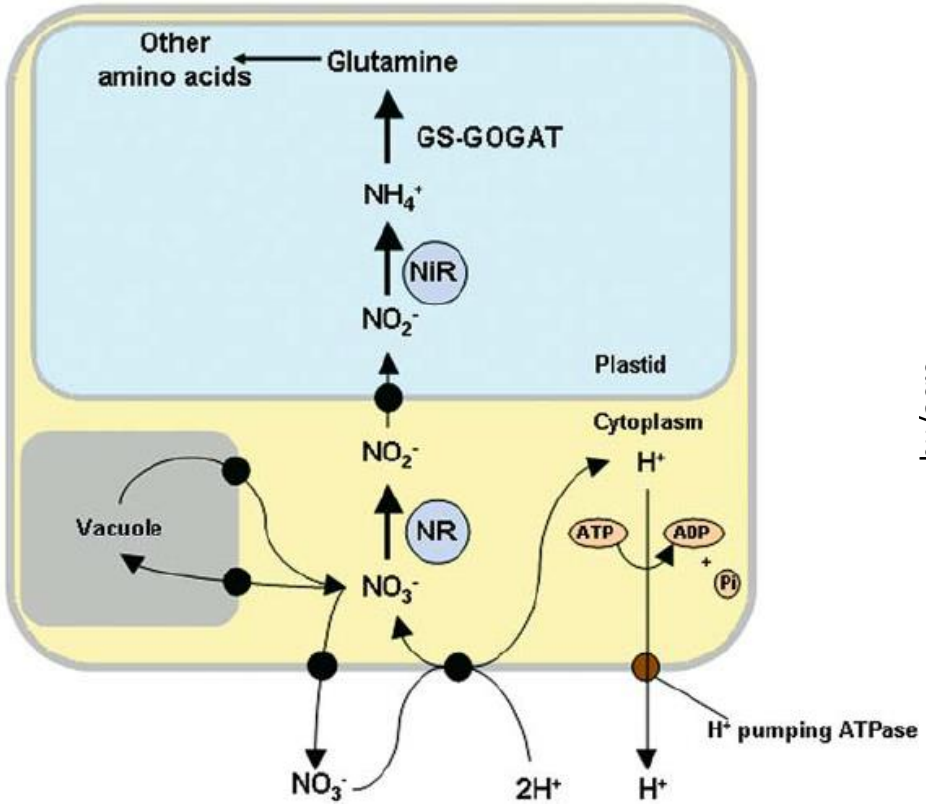
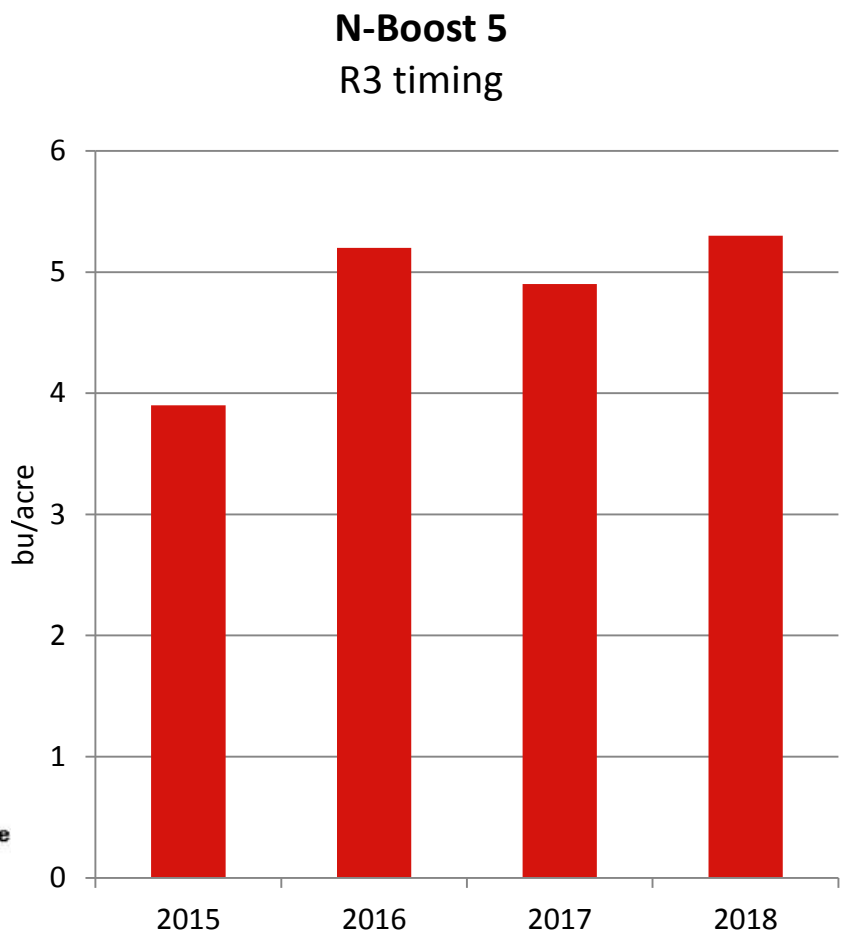
Guaranteed By:
Donaghys Industries Ltd.
63 Bradshaw Street
Dunedin, New Zealand

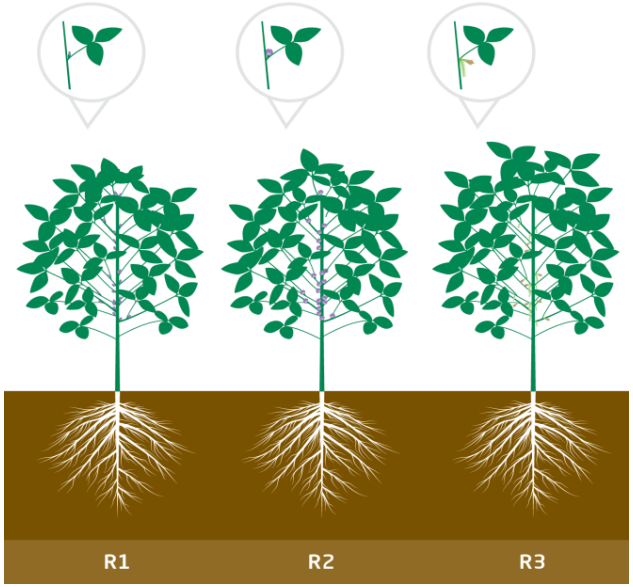
Helps Soybeans Maintain Nitrogen from R3 to R7

N-Boost 5 – Improves Nitrogen Metabolism





Foliar – R Stages - Key Brandt Products



Product	Type	Rate
Brandt Smart Trio	Micro Zn + Mn + S	1 pt/acre
Brandt Smart B Mo	Micronutrient B + Mo	1 qt/acre

BRANDT® Smart B-Mo™
High Performance Foliar Boron

- New boron and molybdenum formulations in BRANDT Smart System foliar nutrient line
- Designed for compatibility and efficiency
- Up to 8x more efficient than 10% boron
- Compatible with other micro's, such calcium and zinc; and crop protection products with very specific pH use ranges
- Allows greater tank mix flexibility and peace of mind

5.0% B

5.0% B
0.5% Mo

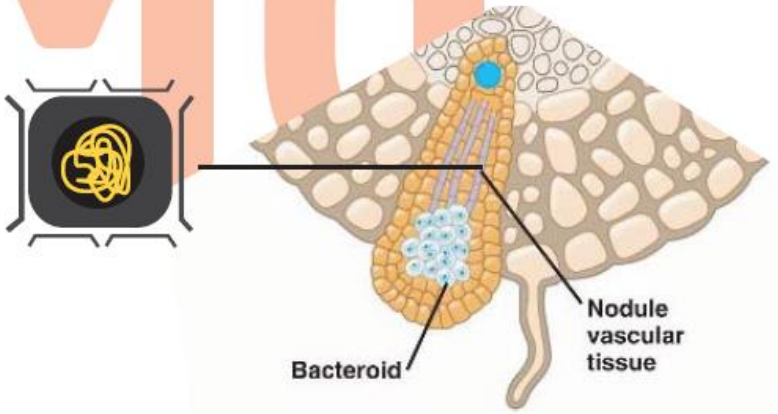
BRANDT® Smart B-Mo™
High Performance Foliar Boron

B BORON

Soybeans, like all legumes, have a high Boron requirement.

- Increased root nodule development for nitrogen fixation
- Increased branching and flowering
- Increased bloom retention
- Increased pod number

MOLY MOLYBDENUM



Required for nitrate reductase activity, vitamin synthesis

NO_3 - Nitrate reductase ⟶ NH_2

Root-nodule bacteria also requires Mo

* Boron in Plant and Animal Nutrition (2002)

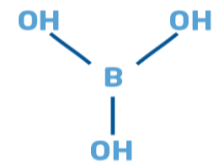
BRANDT®

Brandt Smart B Mo – Research Farm

- 2017 Pleasant Plains Research Farm
- 1 application – at pre-bloom
  Treatments:
  1. 10% Boron (32 oz/acre)
  2. BRANDT Smart B Mo (8oz/acre)

What Makes BRANDT's Proprietary Smart Boron More Mobile

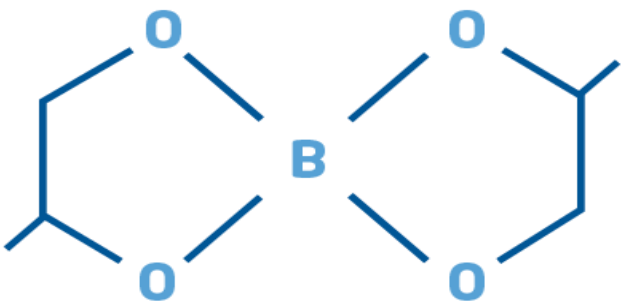
- When traditional boron fertilizers are applied, only a portion of the applied boron will get inside plant growing points. This is because of boron's natural tendency to bind and affix to other elements inside the plant.



Boric Acid

convential boron fertilizer

- In contrast, BRANDT's proprietary boron is "shielded" to prevent binding and tie up as the boron travels to plant growing points
  - BRANDT's boron is cross-linked, which gives it a molecule structure that mimics natural cross linking structures in plants

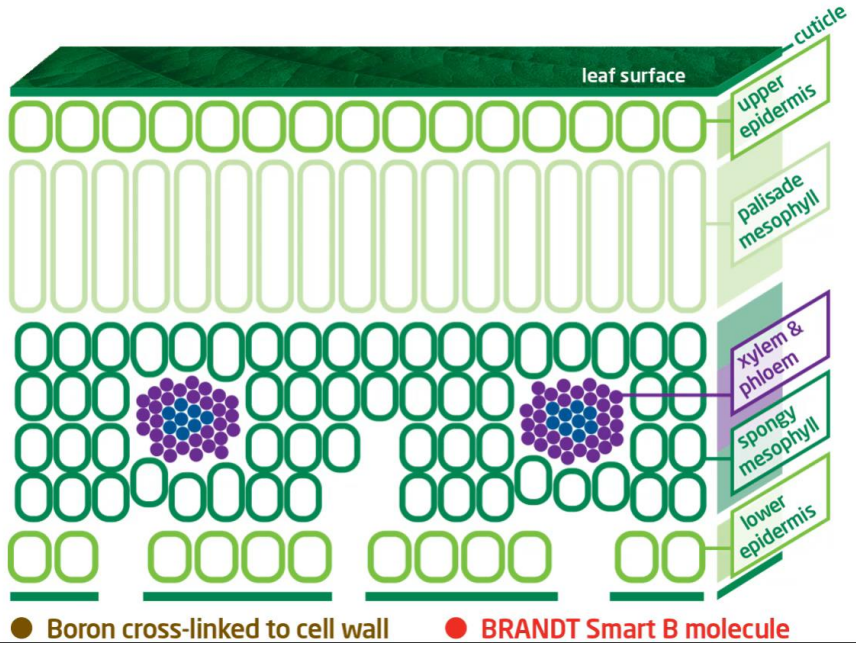


BRANDT Smart B

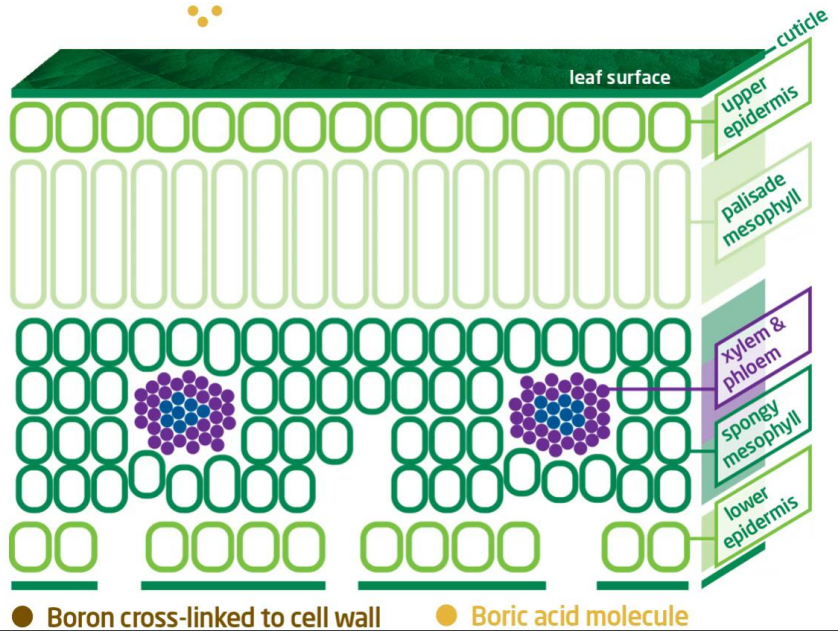
- This provides exceptional mobility of BRANDT Smart B in the plant and outstanding tank mix with crop protection and fertilizers

A Visual Illustration of BRANDT Smart Boron Mobility vs. Conventional Boron Fertilizers

BRANDT Smart B Superior Mobility



Convention Boron Tie Up Inside Plant




This year thousands of Farmers
will die from stubbornness.
NO WE WON'T
Learn the preventive medical tests you need ahrq.gov
LAMAR

Thank you

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