Commercially Available Biological and Humic Acid Seed Treatments

David Moseley, PhD
Assistant Professor – Soybean Specialist
LSU AgCenter

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THE LOUISIANA
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Maximize Yield and Profit Potential

- Find the best ROI for all inputs
  - Variety selection
  - Planting dates and rates
  - Nutrients
    - P, K
    - Micronutrients
    - Nitrogen
    - Biological seed treatments
    - Humic acid/other treatments

Soybean Nitrogen Fixation

- Inoculate with *Bradyrhizobium japonicum* bacteria
  - convert atmospheric nitrogen gas (N_2) into ammonium (NH_4+).
  - Can fix up to approximately 75% of the required nitrogen
  - Red River Research Station: Inoculation even in fields previously grown to soybean have had a 3-7% increase in yield
- Low soil pH: Low availability of molybdenum
  - Do not combine *Bradyrhizobium* and molybdenum as a seed treatment unless it is directly before planting
- Nodules can be evaluated beginning at V3 growth stage (approximately 7 active nodules)

Soybean Nitrogen Fixation

- Legume plant - fix nitrogen (generally no additional nitrogen is required)

Soybean Supplemental Nitrogen

- Soybean takes up approximately 3.75 – 4 pounds of N/bu of grain
- 80 bushels = 300 – 320 lbs of N (Research has shown soybean can fix enough N for 80bu)
- We have recommended 25 to 45 pounds of N/acre (50 to 100 pounds urea: 46-0-0) at R3 – R4 growth stages for expected yield of 70+ bu/acre or in low nodulating environments
- Supplemental nitrogen can decrease the nitrogen fixation process
- 20-year (1996-2016) multi-state aggregated data:
  - N explained <1% of total variability
  - In a few environments N application increased yield 0.14-0.5 bu/A for every 10 lb of N applied

Poor Soybean Nodulation

- Possible Causes
  - Low pH
  - Droughty, saturated soils, or coarse textured soils
  - Compaction
    - Less root hair sites for rhizobia infection and nodulation
  - Extreme temperatures
  - Low correlation between nodule count and nitrogen fixation
  - The nitrogen uptake peaks at R3 to R6
    - Nitrogen fixation has been detected until R6 growth stage
    - However, the BNF process may not produce enough N for high yields
- Can biological or other seed treatments help?


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BRINGING SOYBEAN RESEARCH TO LIGHT

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FUNDED BY THE SOYBEAN CHECKOFF

U.S. farmers are beneficiaries of the practical research results that come from work funded by the soybean checkoff – national, regional and state. Now, Science for Success is adding another element to the effort. The checkoff-funded programis amplifying access to timely, data-driven best management practices (BMPs) so farmers can better manage agronomic sustainability.

SCIENCE FOR SUCCESS gets up-to-date BMP research efficiently into the hands of U.S. soybean farmers through Extension publications, YouTube videos, podcasts, webinars and more, to share the sustainable practice recommendations needed to optimize yield and protect quality.

SOYBEAN SLEUTHS

The Science for Success partnership brings together 17 Extension specialists from land-grant institutions across the country, representing more than 80% of U.S. soybean acres. These specialists contribute their own state-gleaned knowledge and research results to the program. As demands of the soybean industry change, the **Science for Success team will collaboratively use proven research** combined with historic results to adapt BMPs to future challenges.

COLLABORATIVE FUNDS

Many state soybean checkoff programs joined together with support from the United Soybean Board to create Science for Success in 2019. The Extension team now augments state and national funding to support not only coordinated U.S.-scale research efforts, but also production advice at the local level. **For FY22, state checkoffs have invested more than $350,000 and another $48,000 in in-kind funding.** USB has invested about $85,000 for 2022.

REVEALED SOLUTIONS

Ongoing projects funded in 2021 focused on foliar nutrient feeding and sulfur applications in soybeans across 46 and 43 U.S. sites, respectively. **Two challenging field research years allowed for rapid capture of many environments to produce data-driven BMPs.** The team last year also used existing knowledge to generate BMPs on early season soybean management.

- **FOLIAR FERTILIZERS.** Research from 16 states concluded that applying foliar fertilizers in early pod development does not impact soybean yield. Using data from this study to make management decisions can save farmers $4-22 per acre.
- **SULFUR APPLICATIONS.** Common sources of sulfur were evaluated at 19 locations to identify where yield response was most likely to occur. Studies at 25% of them found a significant difference in yields. However, no treatment consistently increased yield. No discernable differences were found in grain protein, oil or amino acid concentrations. Analysis in ongoing to understand site characteristics associated with fertilizer responses.

For more information, visit the Soybean Research and Information Network (SRIN)
https://soybeanresearchinfo.com or your local Extension websites

National Collaboration

Evaluate soybean best management practices

1. Applying foliar fertilizers at R3
2. Commercially available biological seed treatments

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2022 Soybean Seed Treatment Trial

The objectives of this project were:

1. To identify situations where biological seed treatments improve soybean grain yield and profitability

2. To evaluate the influence of biological seed treatments on soybean plant nutrient status.

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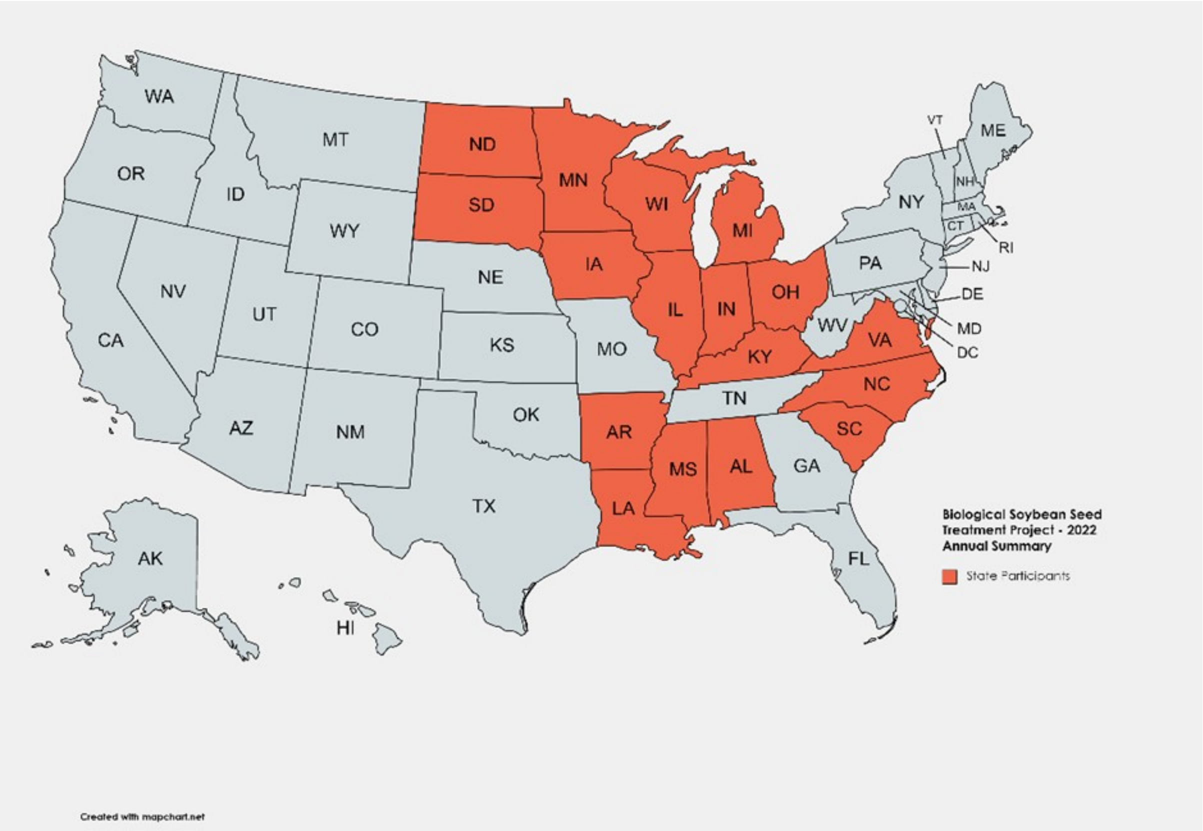
Methodology



In 2022:

- 17 states
- 50 locations in the USA

- Small plot trials
- Randomized complete block design with six to eight replications at all sites
- 9 treatments + 1 control

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2022 Soybean Seed Treatment Trial

Dean Lee Research Station

- Two fields recently planted to soybean
- One maturity group 4.8 XF variety
- Fungicide + Insecticide seed treatment
- Fields 1 and 2: Planted on May 18 and 19
- Fertilized according to soil test
- 1 untreated control
- 11 seed treatments (Six companies)
  - Missing treatment #5 & #6; added 4 treatments

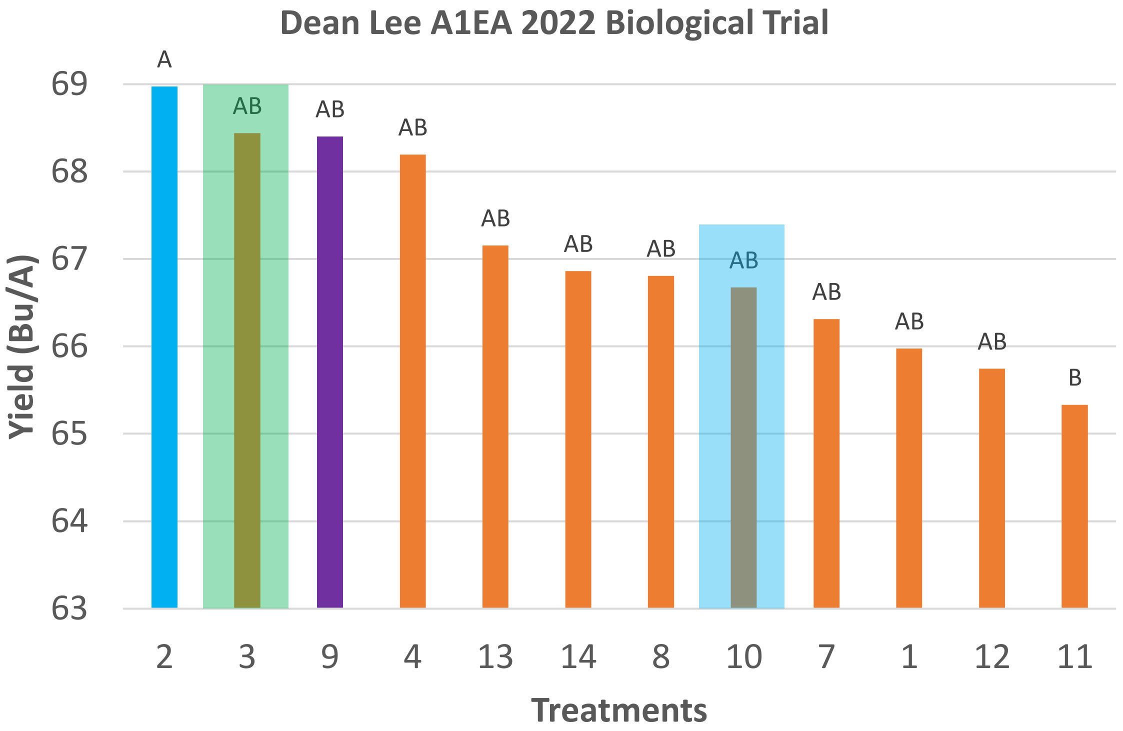
Trt. #	Active ingredients
1	*Azospirillum brasilense, Bacillus licheniformis, Bacillus amyloliquefaciens, Bacillus subtillis, Pseudomonas fluorescens, Rhizobium*
2	*Trichoderma virens*
3	*Bradyrhizobium* spp.
4	*Bacillus subtillis, Bacillus amyloliquefaciens, Bradyrhizobium japonicum*
5	*Pantoea agglomerans*
6	*Pseudomonas brassicacearum*
7	*Bradyrhizobium elkanii and Delftia acidovorans + Bacillus velezensis*
8	*Bacillus velezensis*
9	*Glomus intraradices, Glomus mosseae, Glomus aggregatum, Glomus etunicatum*
10	Untreated Control
11	16% humic acid (leonardite)
12	8.5% organic matter (leonardite) + 8% N + S, Fe, Mn, Zn
13	11.5% organic matter (leonardite) + 4-14-3
14	60-70% humic acid and Fulvic acid (from oxidized leonardite)

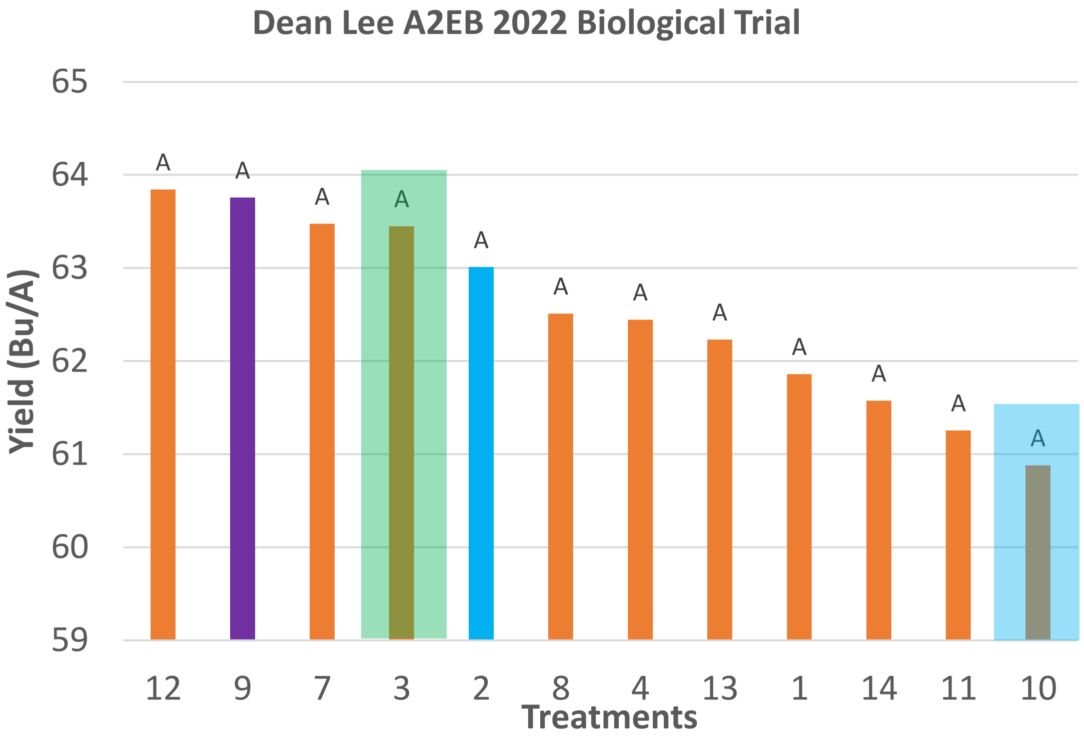
2022 Soybean Seed Treatment Trial

- **8 different biologicals**
  - *Bradyrhizobium:* N-fixing bacteria (50-75% of the required nitrogen)
  - *Delftia:* Promote N-fixation
  - *Azospirillum:* Increased root growth and improved mineral and water uptake
  - *Bacillus:* Promote plant growth and help resist stress
  - *Pantoea:* Promote plant growth and combat plat pathogens; release phosphates
  - *Pseudomonas:* Promote plant growth and resist stress
  - *Glomus: Fungus* – Promote phosphorus uptake (maybe need less P input)
  - *Trichoderma: Fungus* – Decrease biotic stresses
- **4 different combinations of humic acid and nutrients**
  - Humic acid and organic matter can make phosphorus more available and stimulate plant growth

Source	Nparm	DF	DFDen	F Ratio	Prob > F
S4S Trt #	11.0	11.0	55	1.0546	0.4138

Source	Nparm	DF	DFDen	F Ratio	Prob > F
S4S Trt #	11.0	11	51.32	0.383	0.9569





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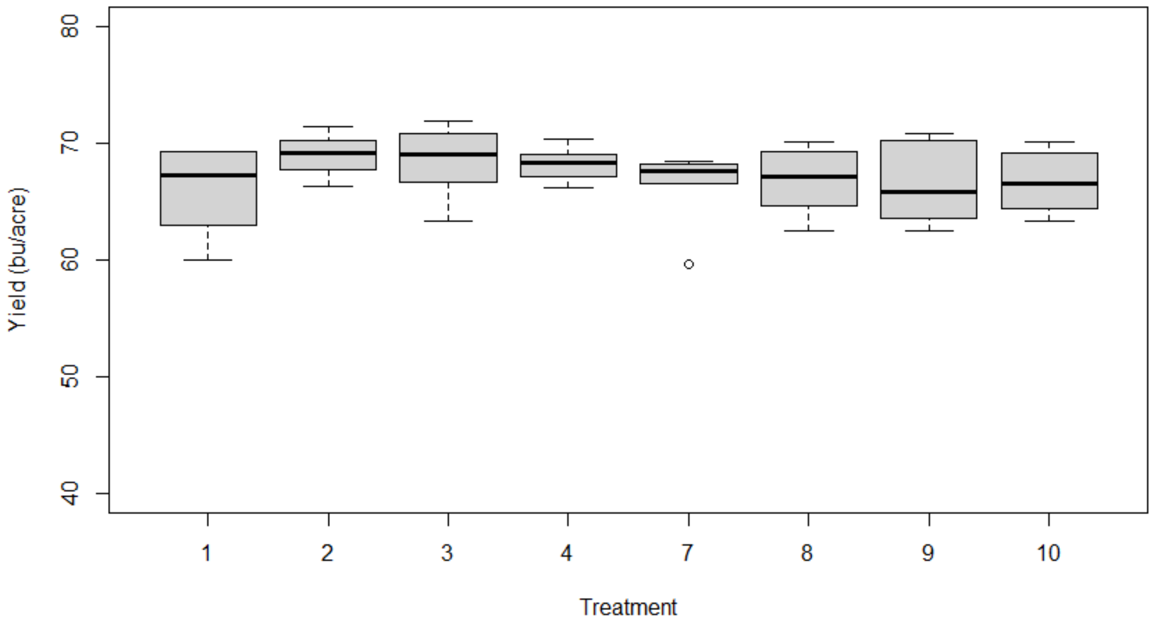
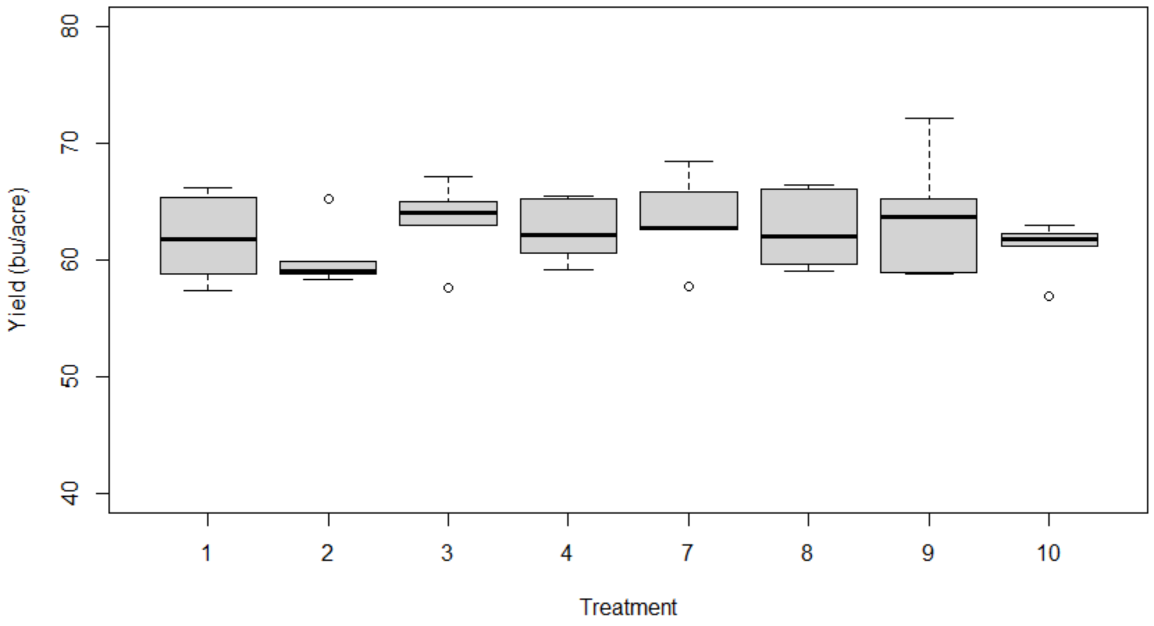
Alexandria (Site 1), Louisiana 2022



Alexandria (Site 2), Louisiana 2022



Treatment (product)	Active ingredients
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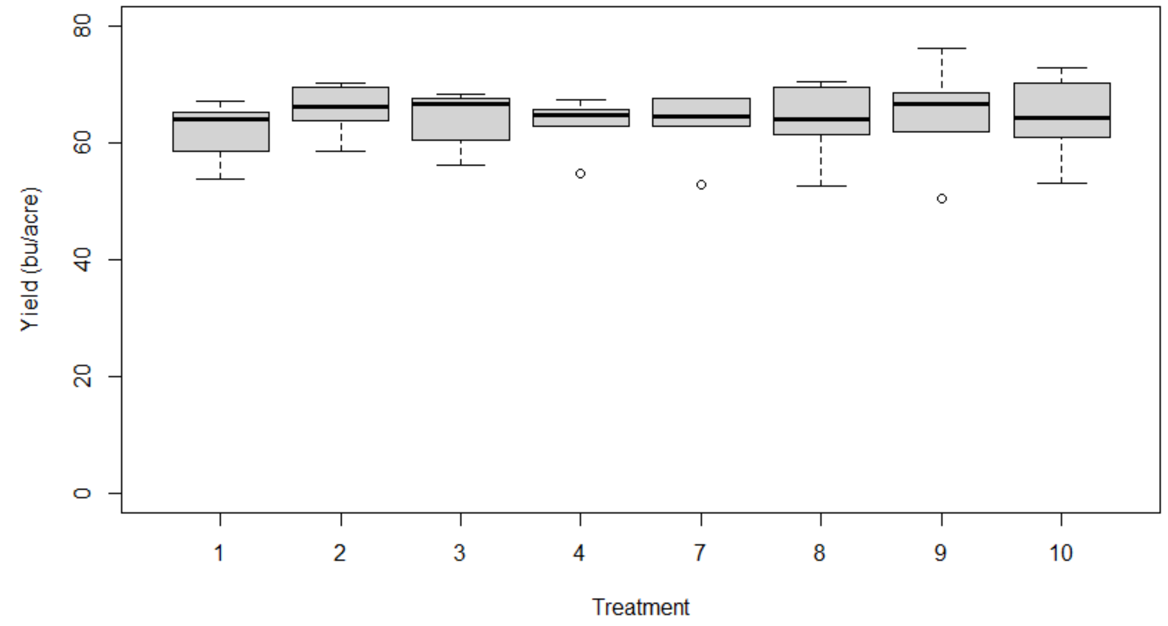
10	Untreated Control

Starkville, Mississippi



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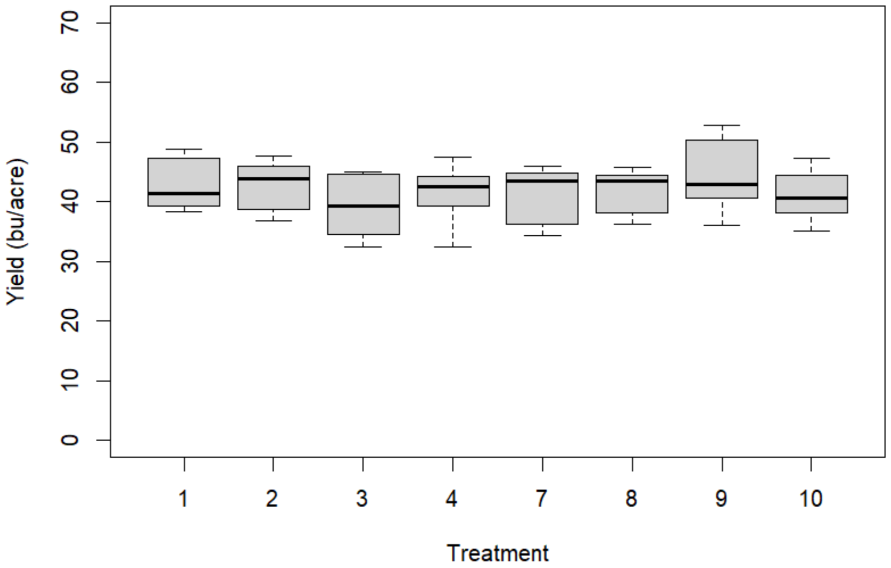
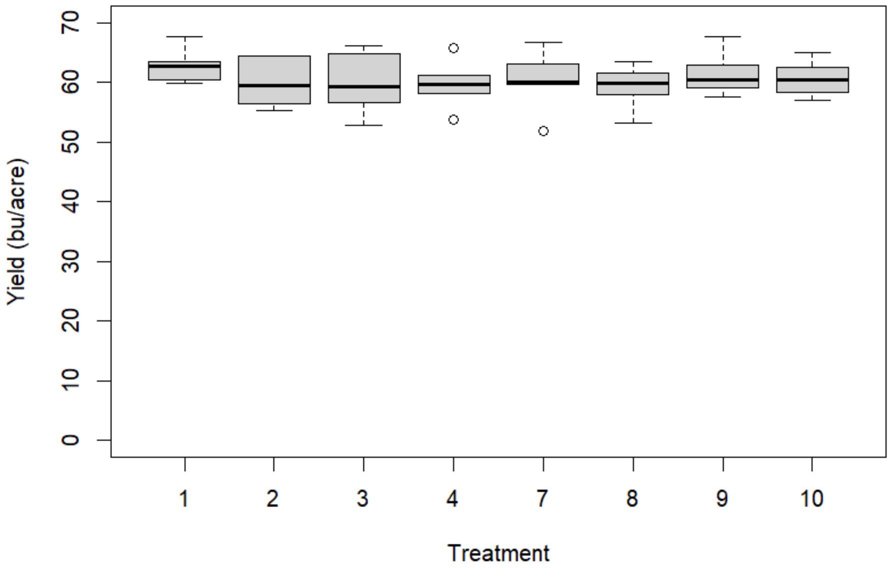
Newport, Arkansas 2022



Colt, Arkansas 2022



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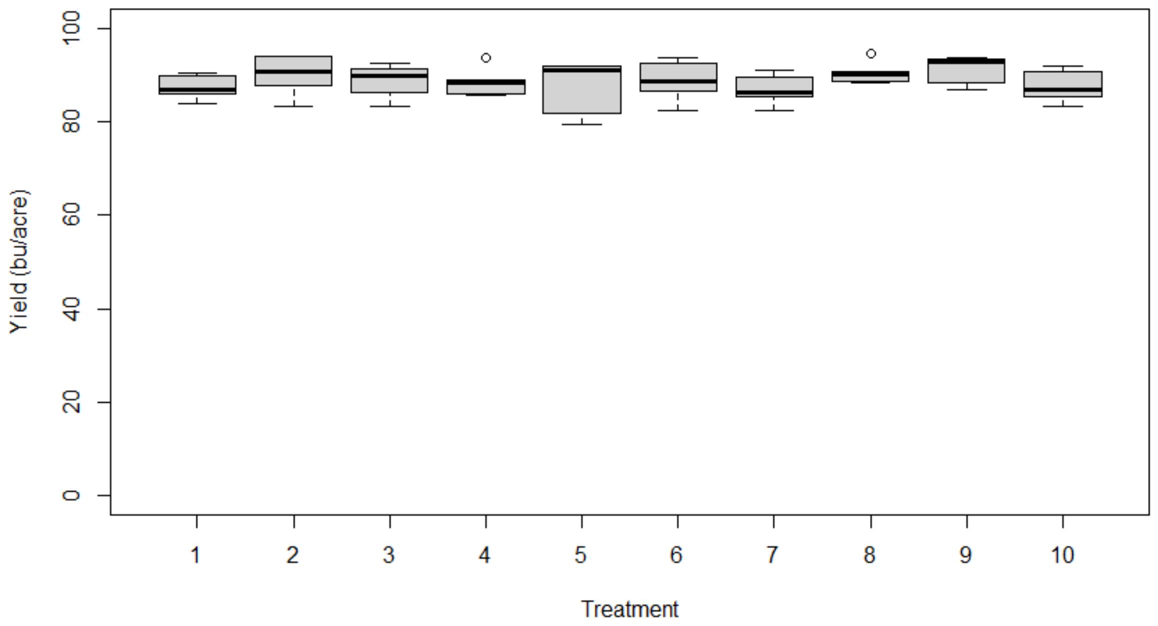
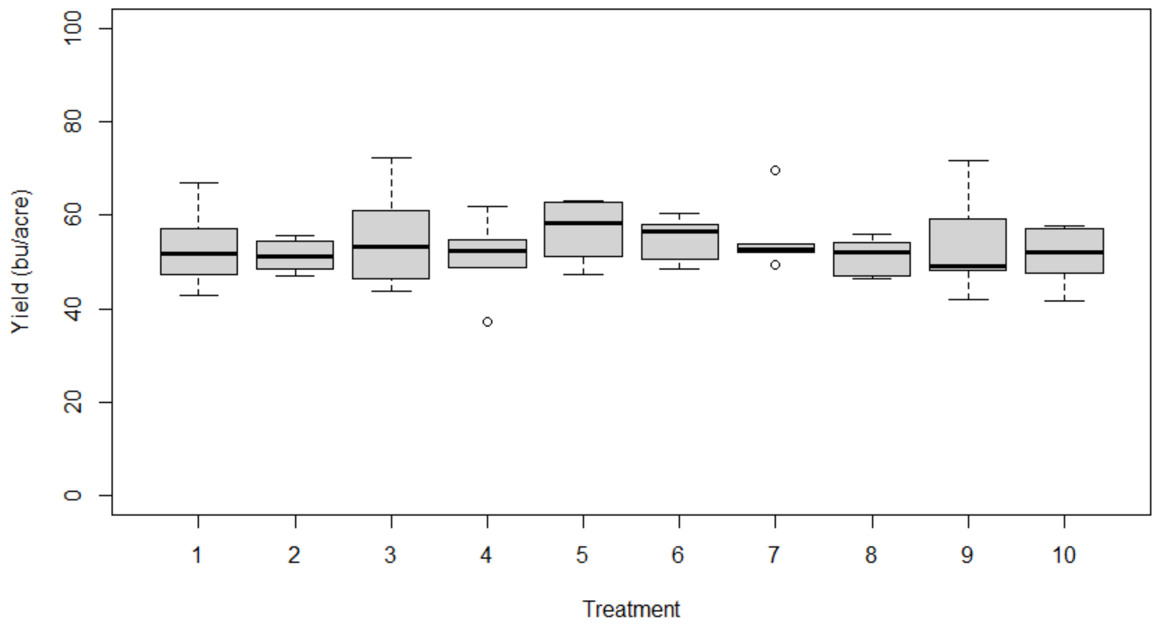
Holgate, Ohio 2022



Marysville, Ohio 2022



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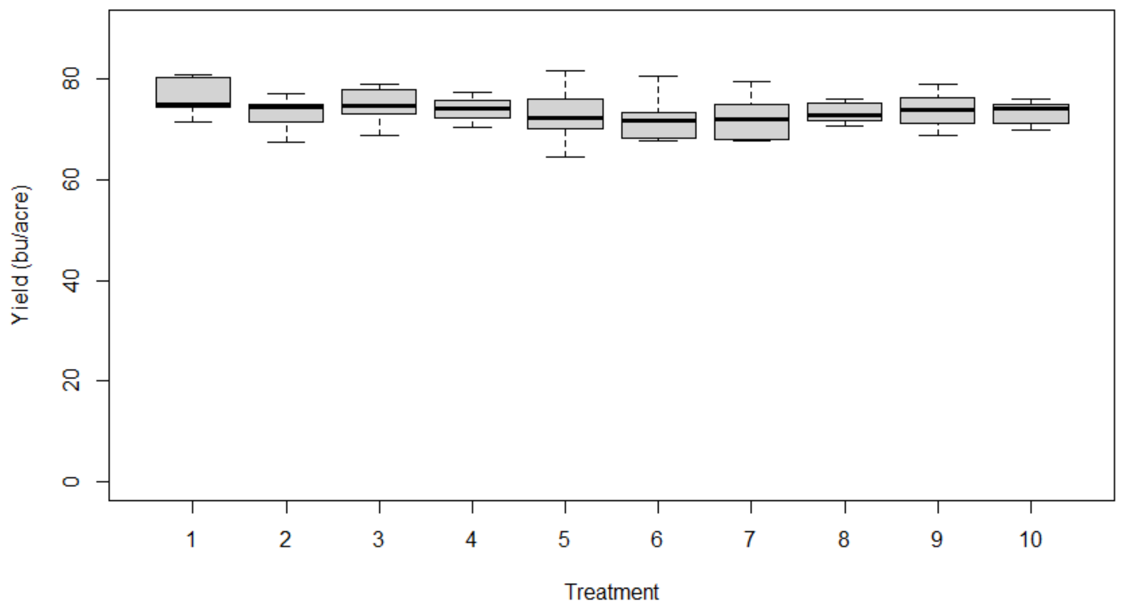
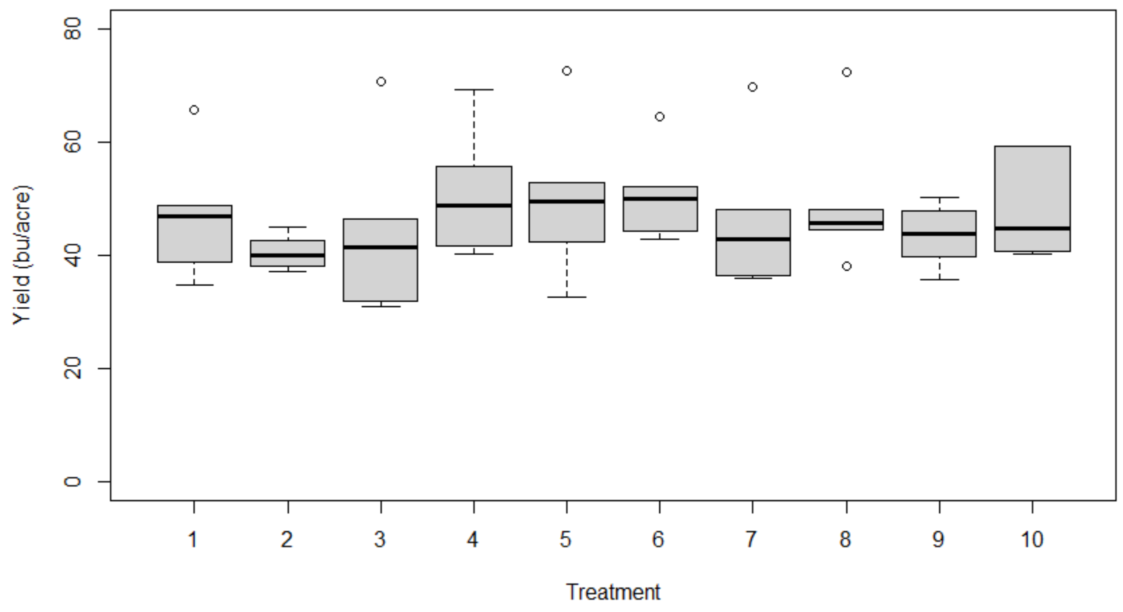
Britton, Michigan 2022



Mason, Michigan 2022



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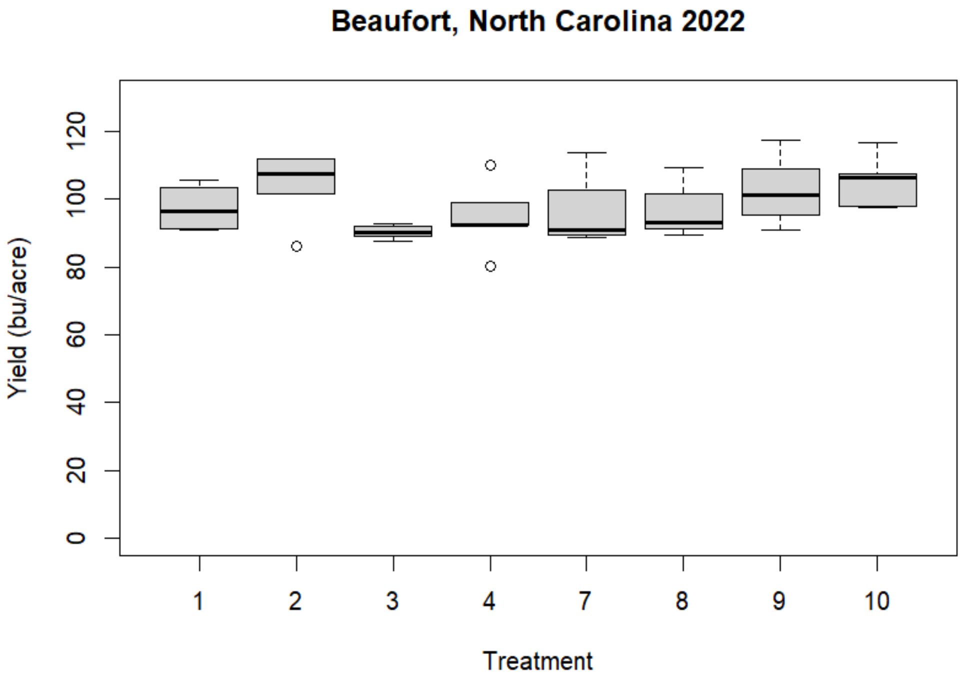

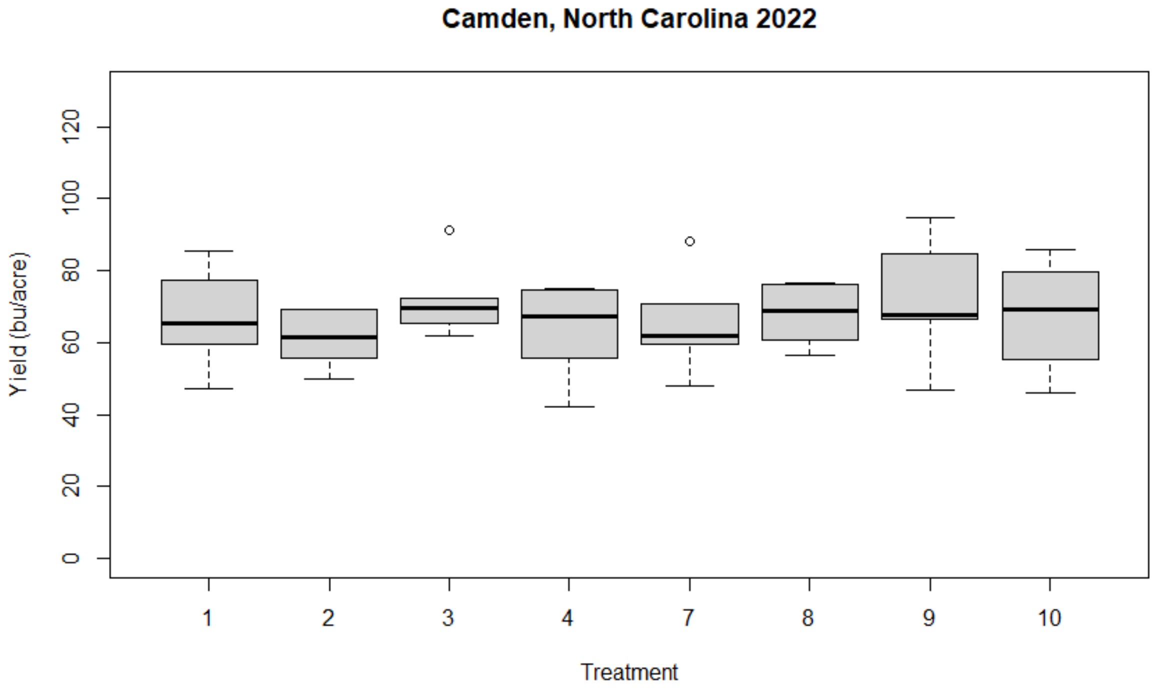

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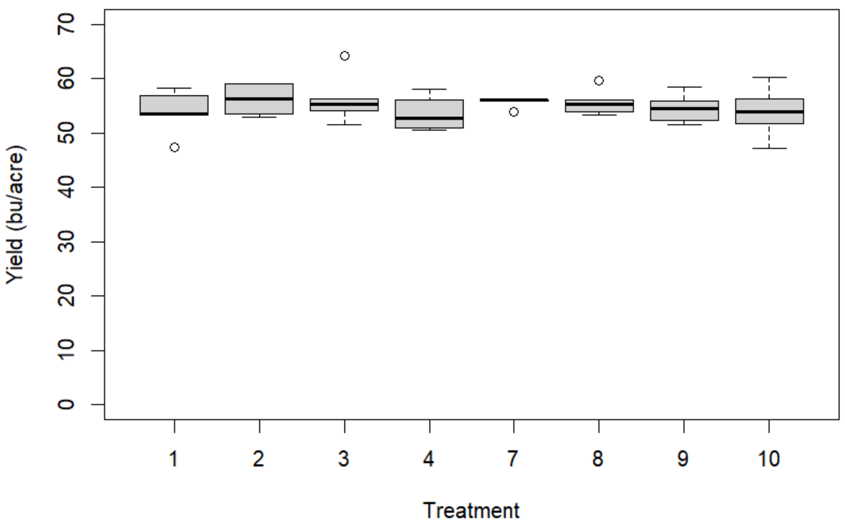
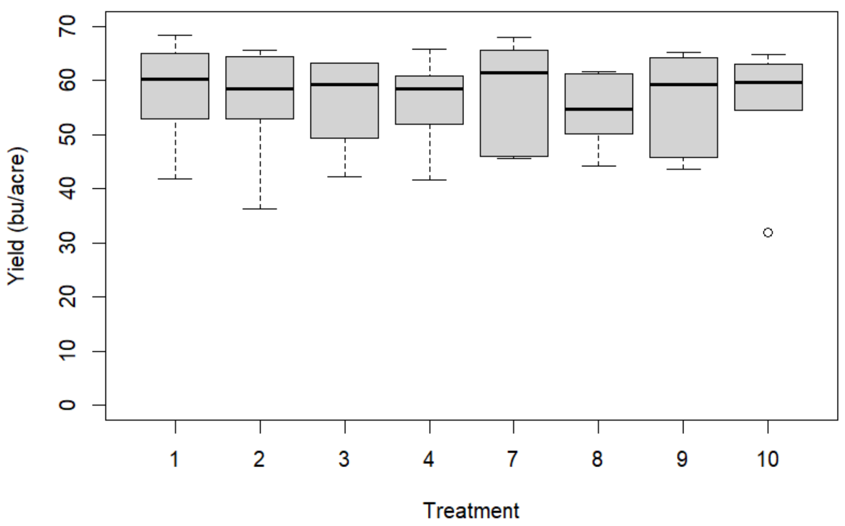
Blackville (Dryland), South Carolina 2022



Blackville (Irrigated), South Carolina 2022



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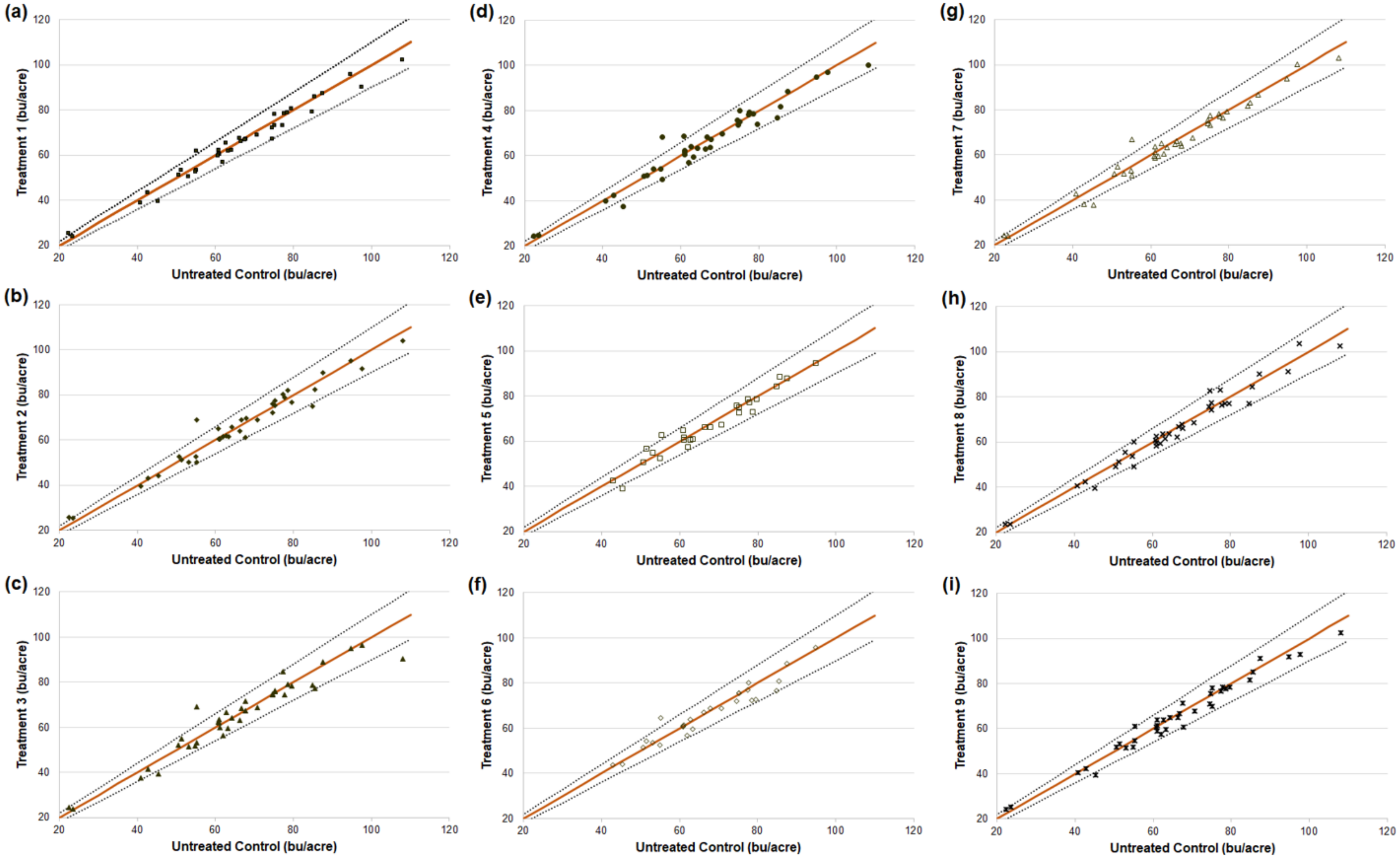

Average grain yield (bu/acre) at each site for each treatment (product) plotted against the average grain yield (bu/acre) of the untreated control (treatment 10) at the same site. Solid red lines represent x = y, and the dashed lines represent ±10% of yield.

Questions

David Moseley
Assistant Professor – Soybean Specialist
Dean Lee Research Station
dmoseley@agcenter.lsu.edu
479-466-0457

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