Assessing Accuracy and Effectiveness of Variable-Rate PGR Applications with Spray Drones in Cotton

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Site-Specific PGR Applications

- Plant growth variability within cotton fields is common because of spatial variability in soil and/or crop features.
- Site-Specific (spot apply/VR) PGR applications is becoming increasingly common to manage in-field plant growth variability.
- Pesticide application technology for site specific management is also advancing for efficient and judicious use of pesticides.

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Spray Drones and Variable-Rate PGR Applications

- The application of pesticides using unmanned aerial vehicles (spray drones) is gaining interest rapidly in the United States.
- Variable-rate PGR applications in cotton is one of the uses of spray drones being talked about (or even implemented in some cases) in the southeastern US.
- Capabilities and limitations of ground sprayers for VR applications have been thoroughly investigated but currently no information is available on accuracy of rate control systems in spray drones.

Hypothesis

The application of variable rate PGR in cotton utilizing a spray drone will have high variability in terms of spray deposition and efficacy.

Objective

To evaluate spray performance during variable-rate applications with a spray drone and assess the effectiveness of VR PGR applications in cotton

Methods and Materials

- **Location**: Tifton, GA (UGA Research Farm)
- **Drone Sprayer**:
  - DJI Agras T40 (DJI Technologies)
  - Capacity: 10.5-gallon tank
  - Rotary atomizers
  - Application height: 10 ft
  - Flight Speed: 15 mph
- **Testing & Data Collection**:
  - Swath testing (bare ground)
  - VR PGR Application (cotton field)

Methods and Materials

- **Swath Testing:**
  - Water and Blue Dye
  - Application Rates
    - 2 GPA
    - 3 GPA
    - 4 GPA
  - Single Rate Application
    - 24 ft - across the swath
    - 150 ft - along the swath

Methods and Materials

- **Field Testing**
  - PGR *(Mepiquat Chloride)*
  - 8 Row Plots
  - 24 ft Swath
  - Application Rates *(PGR rate)*
    - 2 GPA *(8 oz/ac)*
    - 3 GPA *(10 oz/ac)*
    - 4 GPA *(12 oz/ac)*
  - Variable-Rate Application
    - Prescription map
    - 26 Acre Field

Data Collection

Spray Deposition:

- 11.4 ml of dye was added to a gallon of water before spraying.
- Using 2.25” wide paper rolls of 150 feet length were placed on swath boards.

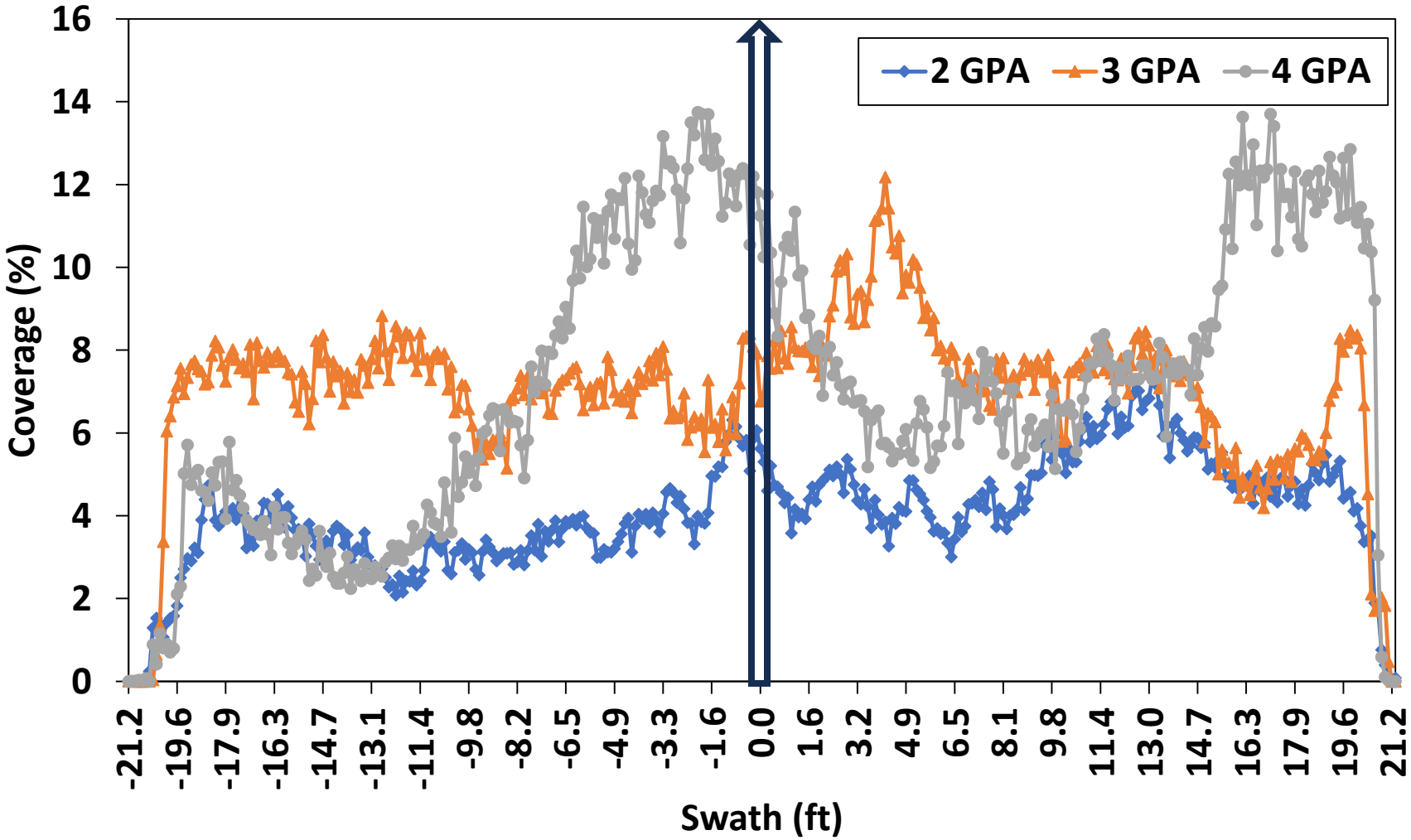
PGR Efficacy:

- Plant height, number of nodes, and number of nodes above white flower were recorded before PGR application and 14 days after application.

Data Analysis

- Paper rolls were analyzed using Swath Gobbler (Application Insight, LLC).
- Spray Coverage (%) data at a resolution of 1.39 inch was calculated.
- Calculated Mean and CV across and along the swath.
- All statistical analysis was conducted using JMP Pro 16.0 (SAS Institute, NC).
- Data were subjected to ANOVA using $\alpha = 0.05$.
- Means were separated using the Student's t-test ($p \leq 0.05$).

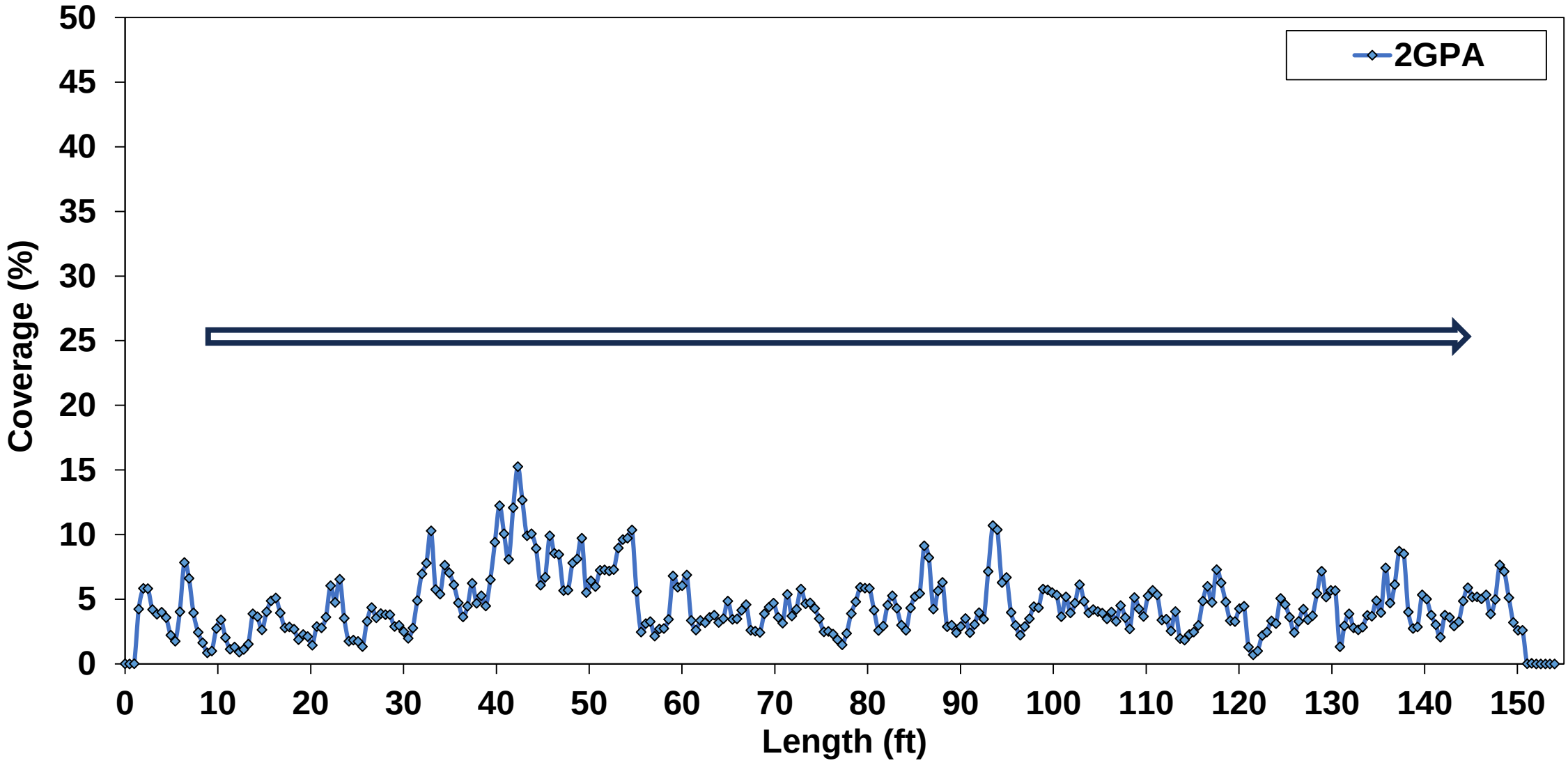
Results - Spray Deposition Within the Swath



Rate (GPA)	Mean Coverage (%)	CV (%)
2.0	3.9 b	34.8
3.0	6.6 a	37.4
4.0	6.5 a	51.7

CV less then 25% is acceptable as per ASABE standard S386.2

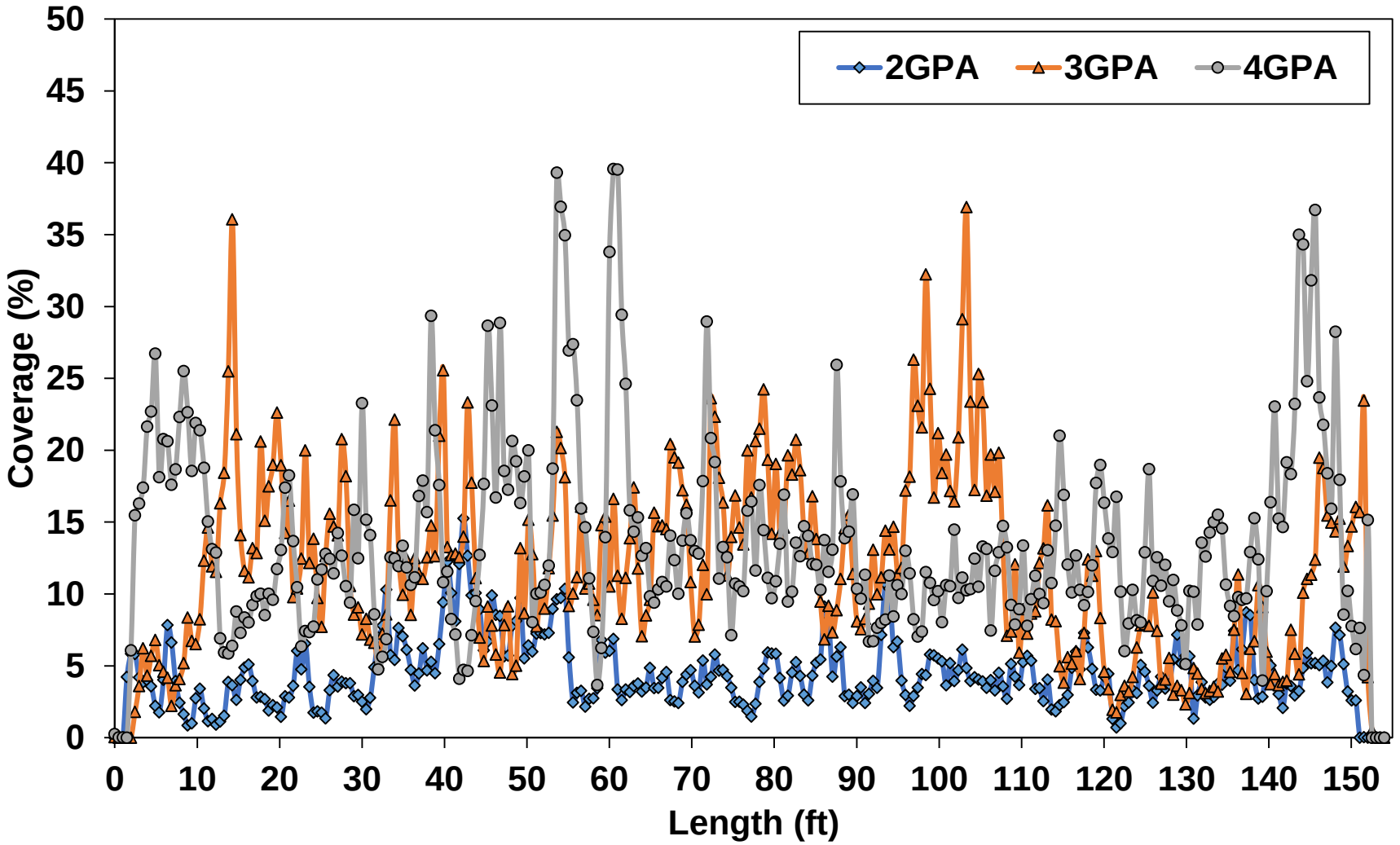
Spray Deposition Along the Swath



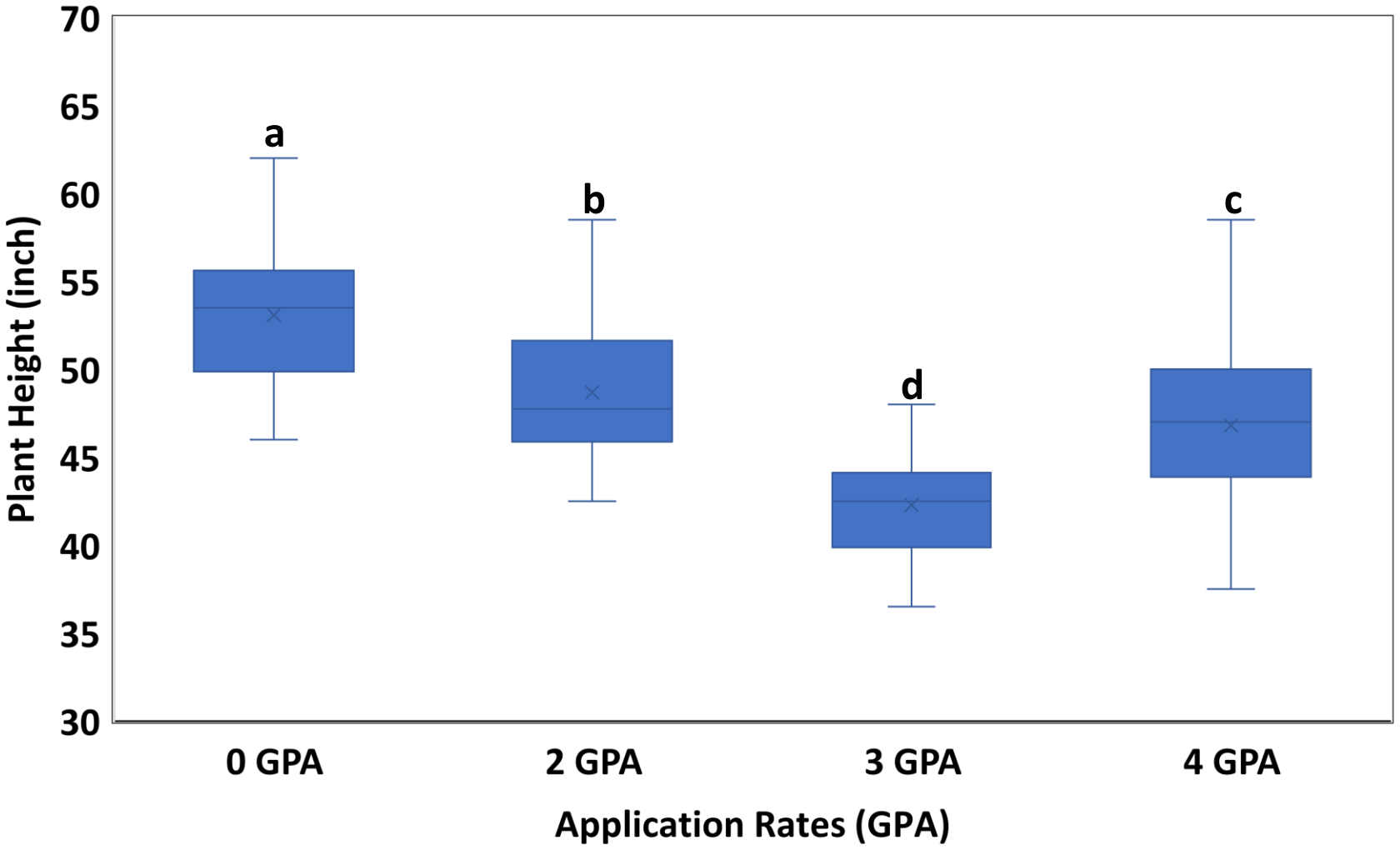
Spray Deposition Along the Swath

Rate (GPA)	Mean Coverage (%)	CV (%)
2.0	3.7 b	60.5
3.0	11.8 a	71.7
4.0	12.7 a	75.9

CV less then 25% is acceptable as per ASABE standard S386.2

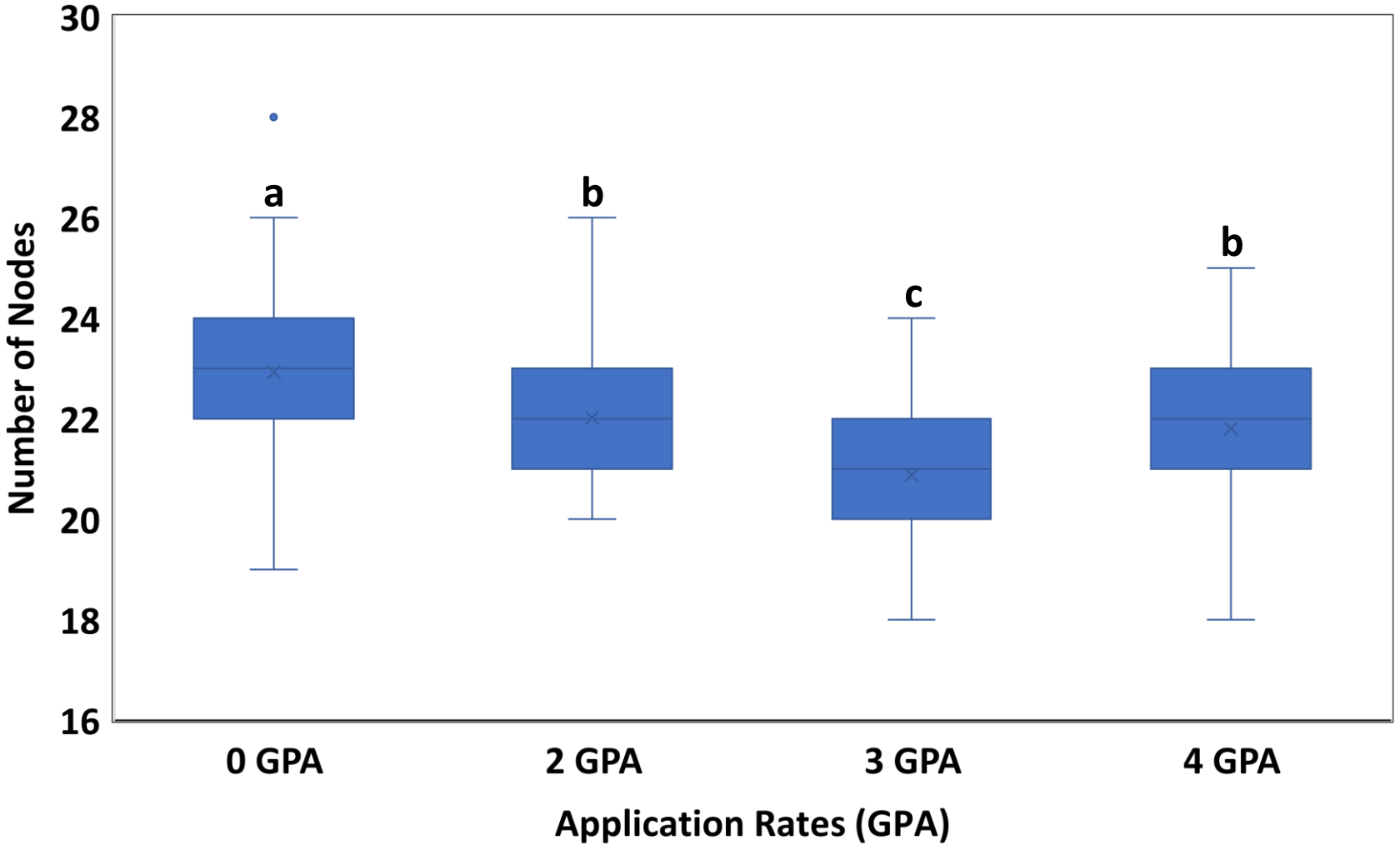


PGR Efficacy - Plant Height



Levels not connected by same letter are significantly different ($p \leq 0.05$)

Number of Nodes



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Conclusions

- **Coverage Variation** – High variation across the swath (CV 35 – 52 %) and along the swath (CV 60 – 76 %).

- **Variable Rate applications** – Due to high variation within single rate along the swath, actual rate for VR application may not be accurate.

- **Efficacy** – There is significant difference between control and all the treatments.

Future Research:
Applied Rate & Efficacy – Detailed study of parameter affecting actual rates in the transition zones.

Spray Prescription map - Sprayer rate controller setup (sensitivity) and response time (distance).

Thanks!

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