Does Plant Growth Regulator Use Impact Boll Size and Locule Number in Cotton?

Trial Objective

- Over the last several seasons, the Scott Learning Center has evaluated the impacts of plant growth regulator (PGR) use, plant spacing, seeding rate, and variety selection on cotton boll size, development, and locule number. Data from these studies have indicated that the number of locules that a cotton boll develops can be influenced by many these factors, and that bolls with five locules tend to have higher seed cotton weight, lint weight, and seed quantity than four locule bolls.
- This work has been continued in 2023, with the SLC staff positionally mapping 11 cotton varieties to document yield accumulation, locule numbers, and additional important characteristics associated with cotton boll development.
- This data can be one component to help explain the effects plant growth regulators can have in cotton and the compensatory ability of cotton plants in regard to changes in boll size/weight.

Research Site Details

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (lb/acre)	Seeding Rate (seeds/acre)
Scott, MS	Commerce/Forrestdale Silt Loam	Corn	Conventional	5/9/2023	9/29/2023	2000	42,000

- There were 12 Deltapine® brand cotton varieties planted in this trial:
  - DP 2211 B3TXF
  - DP 2115 B3XF
  - DP 2317 B3TXF
  - 22R2222 B2TXF*
  - 21R4123B3TXF*
  - DP 2328 B3TXF
  - DP 2131 B3TXF
  - DP 2333 B3XF
  - 21R4334 B3TXF*
  - DP 2038 B3XF
  - DP 2239 B3XF
- This trial included three of the New Product Evaluator (NPE) varieties tested during 2023 (see asterisks). These products were not advanced but have been included in this study as they provide additional data points to support the cotton physiology objective of this dataset.

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- Plant growth regulator (PGR) treatments included:
  - » Untreated control (UTC)
  - » Aggressive (AGG) PGR management with 4.2% mepiquat applied at the following timing:
    - – 6/20/2023: 16 fl oz/acre at 7 nodes
    - – 7/6/2023: 16 fl oz/acre at 12 nodes
    - – 7/17/2023: 16 fl oz/acre at 15 nodes
- The trial was planted into a field with 140 lb nitrogen (N) surface applied as 30-0-0-2.5 prior to layby.
- Each treatment was planted as a 6-row strip trial with 0.17 to 0.21 acres per plot.
- All field work, tillage, and herbicide applications were per local standards.

Data were collected as follows:

Figure 1. An example of how the Boll-O-Meter was used to record the fruiting profile for each cotton variety.

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Positional Mapping

- The Boll-O-Meter (Figure 1) was used to document fruiting profile and accumulation for each cotton variety by PGR application.
- Six row feet per plot were mapped using the Learning Center standard protocol.
- Data were assimilated post-mapping for analysis.
- Seed cotton samples were weighed, ginned, and delinted into cohorts for each locule treatment. After mapping each variety/PGR combination, bolls were bulked as follows into the following cohorts:
  - 4 Locule Bolls
  - 5 Locule Bolls
- Fiber quality and turnout were derived from these samples for the various parameters.

Trial Analysis

- Cotton variety was held as replicate (n=11) and PGR Treatment as main effect (n=2).
- Standard Least Square Mean ANOVA performed via JMP to establish statistical differences.
- In the event of statistical significance ($p < 0.05$) means were separated using Fisher's protected LSD.
- Comparisons between four and five locule samples (seed, weight, and fiber properties) were made using Student's t-test and reported when significantly different at $p < 0.05$.

Understanding the Results

A total of 3869 cotton bolls were mapped in 2023 across all treatments and fruit types. Of the bolls mapped, 69% (2664) of the bolls were four locule and 31% (1205) were five locule.

Boll Size – Bulk estimations across both four and five locule bolls; this is across bolls produced on both sympodial and monopodial branches.

- Seed cotton per boll – Aggressive PGR use generated significantly heavier bolls (data not shown).
  - AGG: 3.98 grams seed cotton/boll
  - UTC: 3.66 grams seed cotton/boll
  - P = 0.0350
  - LSD = 0.27
- Lint per boll – Aggressive PGR use generated significantly heavier bolls (Figure #, panel #/data not shown).
  - AGG 1.69 grams lint cotton/boll
  - UTC 1.56 grams lint cotton/boll
  - P = 0.0414
  - LSD = 0.12

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PGR Influence on Locule Number

- Across all bolls produced (both monopodial and sympodial bolls)
  - » Percent of bolls with five locules (Table 1):
    - – AGG = 33.46%
    - – UTC = 27.59%
    - – P = 0.0534
    - – LSD = 5.69
  - » Weight contribution of five locule bolls to total weight (Table 2):
    - – AGG = 38.94%
    - – UTC = 32.57%
    - – P = 0.0880
    - – LSD = NS
- Sympodial bolls only
  - » Percent of bolls with five locules (Table 1):
    - – AGG = 36.90%
    - – UTC = 28.32%
    - – P = 0.0111
    - – LSD = 6.01
  - » Weight contribution of five locule bolls to total weight (Table 2):
    - – AGG = 42.54%
    - – UTC = 33.78%
    - – P = 0.0189
    - – LSD = 7.23

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Observations on Lint Percent, Boll Weight and Seed Parameters. A non-paired, two tailed t-test ($P<0.05$) was used to compare the populations of the boll types across the entire experiment.

- Lint percent (Figure 2, Panel 1)
  - Four locule bolls: 42.55%
  - Five locule bolls: 42.00%
  - Prob>|t| = 0.1016
  - Four and five locule boll data indicated statistically similar turnout.
- Seed cotton per boll (Figure 2, Panel 2)
  - Four locule bolls: 3.55 g/boll
  - Five locule bolls: 4.53 g/boll
  - Prob>|t| = < 0.0001
  - Bolls with five locules weighed significantly more (27.6% more) than four locule bolls.
- Lint per boll (Figure 2, Panel 3)
  - Four locule bolls: 1.45 grams/boll
  - Five locule bolls: 1.83 grams/boll
  - Prob>|t| = <0.0001
  - Bolls with five locules produced significantly more (26.2% more) lint than four locule bolls.
- Delinted seeds per boll (Figure 2, Panel 4)
  - Four locule bolls: 21.66 seeds/boll
  - Five locule bolls: 27.12 seeds/boll
  - Prob>|t| = <0.0001
  - Five locule bolls produced significantly higher (25.2% more) numbers of seeds per boll.
- Seeds per locule (Figure 2, Panel 5)
  - Four locule bolls: 5.52 seeds/locule
  - Five locule bolls: 5.43 seeds/locule
  - Prob>|t| = 0.9527
  - Four locule and five locule bolls contained statistically similar numbers of seeds per locule.

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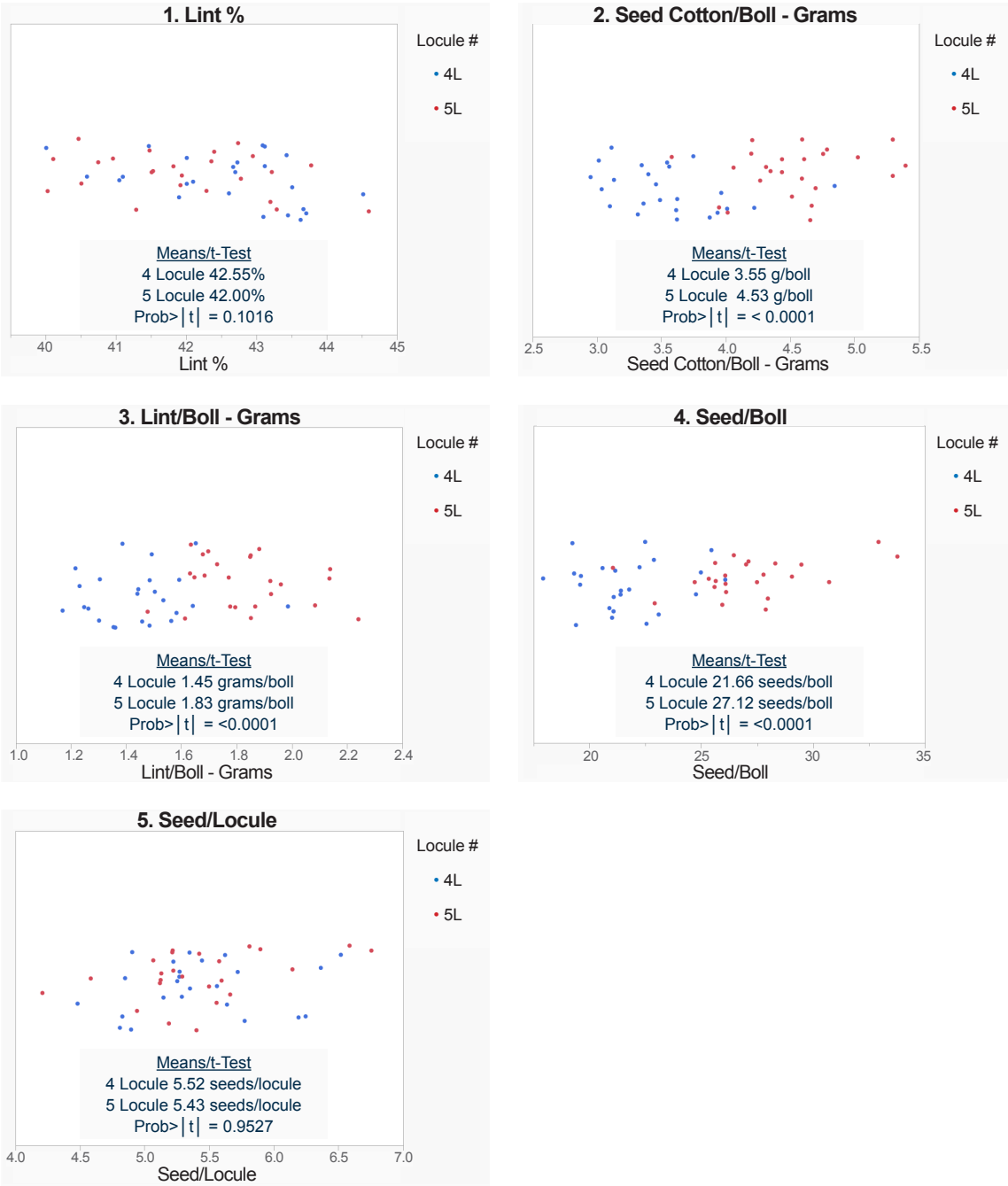

Figure 2. Lint percent (Lint%), seed cotton per boll (Seed Cotton/Boll – Grams), lint per boll (Lint/Boll - Grams), delinted seeds per boll (Seed/Boll), and seeds per locule (Seed/Locule) for four and five locule bolls at Scott, MS (2023).

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- Fiber Quality Testing – A few samples were either lost in laboratory sampling or not large enough to perform High Volume Instrument (HVI) testing. Therefore, data sample numbers vary. Sample sizes are listed below.
  - » Fiber Length (Figure 3, Panel 1) – (Sample size number: 4L = 23; 5L = 23)
    - – Four locule bolls: 1.13 inches
    - – Five locule bolls: 1.14 inches
    - – Prob>|t| = 0.3184
    - – Four and five locule bolls had statistically similar fiber length.
  - » Fiber Strength (Figure 3, Panel 2) – (Sample size number: 4L = 23; 5L = 23)
    - – Four locule bolls: 28.48
    - – Five locule bolls: 27.88
    - – Prob>|t| = 0.2962
    - – Four and five locule bolls had statistically similar fiber strength.
  - » Micronaire (Figure 3, Panel 3) – (Sample size number: 4L = 22; 5L = 19)
    - – Four locule bolls: 4.82
    - – Five locule bolls: 4.81
    - – Prob>|t| = 0.9564
    - – Four and five locule bolls had statistically similar micronaire.
  - » Uniformity (Figure 4, Panel 4) – (Sample size number: 4L = 23; 5L = 23)
    - – Four locule bolls: 82.66
    - – Five locule bolls: 83.07
    - – Prob>|t| = 0.1983
    - – Four and five locule bolls had statistically similar uniformity.

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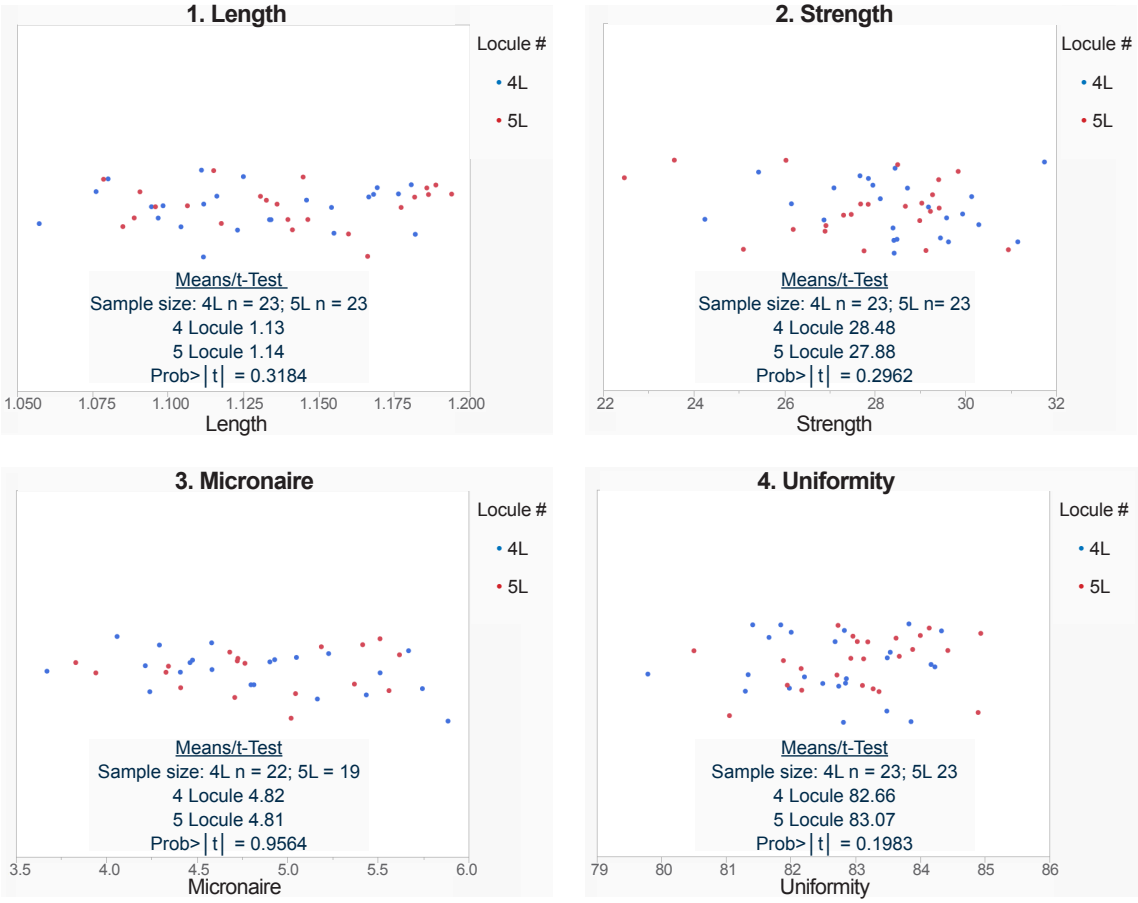

Figure 3. Fiber quality parameters tested including fiber length (Length), fiber strength (Strength), micronaire (Micronaire), and uniformity (Uniformity) for four and five locule bolls sampled at Scott, MS (2023).

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Table 1. Percentage of bolls with five locules produced on both monopodial and sympodial branches and on sympodial branches only by cotton variety, Scott Learning Center, Scott Mississippi (2023).

Deltapine® Brand Cotton Variety	Bolls from Monopodial and Sympodial Branches		ONLY Bolls from Sympodial Branches	
	Untreated Control (UTC)	Aggressive PGR Management (AGG)	Untreated Control (UTC)	Aggressive PGR Management (AGG)
DP 2333 B3XF	31.85	26.58	33.33	28.00
DP 2328 B3TXF	17.42	40.74	18.80	43.69
DP 2317 B3TXF	30.83	35.77	31.11	39.05
DP 2239 B3XF	36.23	36.59	33.93	39.02
DP 2211 B3TXF	30.04	32.73	32.10	36.00
DP 2131 B3TXF	25.49	37.97	25.38	41.67
DP 2115 B3XF	21.62	27.56	25.88	31.58
DP 2038 B3XF	47.02	45.76	48.15	47.58
22R2222 B3TXF	42.60	43.69	42.19	51.69
21R4334 B3TXF	12.40	21.55	13.33	24.26
21R4123 B3TXF	8.02	19.08	7.33	23.33
Average	27.59	33.46	28.32	36.90

Table 2. Percentage of weight produced by bolls with five locules on both monopodial and sympodial branches and on sympodial branches only by cotton variety, Scott Learning Center, Scott Mississippi (2023).

Deltapine® Brand Cotton Variety	Bolls from Monopodial and Sympodial Branches		ONLY Bolls from Sympodial Branches	
	Untreated Control (UTC)	Aggressive PGR Management (AGG)	Untreated Control (UTC)	Aggressive PGR Management (AGG)
DP 2333 B3XF	32.60	26.34	33.04	26.78
DP 2328 B3TXF	24.74	49.49	26.78	52.63
DP 2317 B3TXF	39.86	41.91	40.43	44.92
DP 2239 B3XF	37.32	41.07	36.55	45.51
DP 2211 B3TXF	38.21	37.35	42.35	41.23
DP 2131 B3TXF	32.64	46.05	32.17	49.71
DP 2115 B3XF	24.73	34.12	29.82	38.85
DP 2038 B3XF	54.70	49.49	56.03	52.83
22R2222 B3TXF	48.98	50.36	49.19	56.73
21R4334 B3TXF	14.29	25.83	15.77	28.90
21R4123 B3TXF	10.25	26.32	9.48	29.89
Average	32.57	38.94	33.78	42.54

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Key Learnings

- When considering both boll types as individual populations, aggressive PGR use generated significantly heavier bolls both in seed cotton weight and lint weight per boll.
- In this trial, aggressive PGR management significantly increased the percentage of bolls with five locules. This was particularly true for bolls produced on sympodial structures.
- Five locule bolls across this study contributed disproportionally (6 to 8% more) to the yield of these mapped plants than four locule bolls. This was true in both aggressively managed and UTC treatments and was particularly true when considering sympodial bolls alone.
- Five locule bolls produced significantly more delinted seeds per boll than four locule bolls.
- Four and five locule bolls produced similar numbers of delinted seeds per locule.
- Four and five locule bolls had similar fiber length, strength, micronaire, and uniformity.
- Cotton varieties have different responses to PGR in many parameters. Locule number determination is no different, in that some varieties produce more five locule bolls inherently and some respond differently to PGRs.
- Previous data generated by the Scott Learning Center indicated that seeding rate, plant spacing, and cotton variety can influence the production of five locule bolls. Current data additionally suggests PGR use can also influence five locule boll production.
- This should not be viewed as a management technique, but rather as further understanding of ongoing observations from many cotton production environments.
- Please contact your local Deltapine® brand representative for more information.

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Legal Statements

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It is a violation of federal and state law to use any pesticide product other than in accordance with its labeling. NOT ALL formulations of dicamba, glyphosate or glufosinate are approved for in-crop use with products with XtendFlex® Technology. ONLY USE FORMULATIONS THAT ARE SPECIFICALLY LABELED FOR SUCH USES AND APPROVED FOR SUCH USE IN THE STATE OF APPLICATION. Contact the U.S. EPA and your state pesticide regulatory agency with any questions about the approval status of dicamba herbicide products for in-crop use with products with XtendFlex® Technology.

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Performance may vary, from location to location and from year to year, as local growing, soil and environmental conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on their growing environment.

The recommendations in this material are based upon trial observations and feedback received from a limited number of growers and growing environments. These recommendations should be considered as one reference point and should not be substituted for the professional opinion of agronomists, entomologists or other relevant experts evaluating specific conditions.

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