Update on Module Averaging

Robbie Seals Director, Grading Division

**USDA, AMS, Cotton and Tobacco Programs**

What is Module Averaging?

- **Voluntary Program offered by USDA, AMS, Cotton Program since 1991 to all customers at no additional charge.**

- **For a given module:**

    All individual HVI measurements for length, strength, length uniformity, and micronaire are taken and averaged. The average for each of these quality factors is assigned to all of the bales within the module.

History: Module Averaging

- Module Averaging was first offered in 1991 for strength.

- First implemented as a result of a recommendation from the Secretary of Agriculture's Advisory Committee on Cotton Marketing as a means to reduce the variability associated with strength.

- Module Averaging was expanded in 1992 to include length, strength, length uniformity, and micronaire.

CONCEPT: All cotton within a module or trailer is well blended by the time it is baled and sampled.
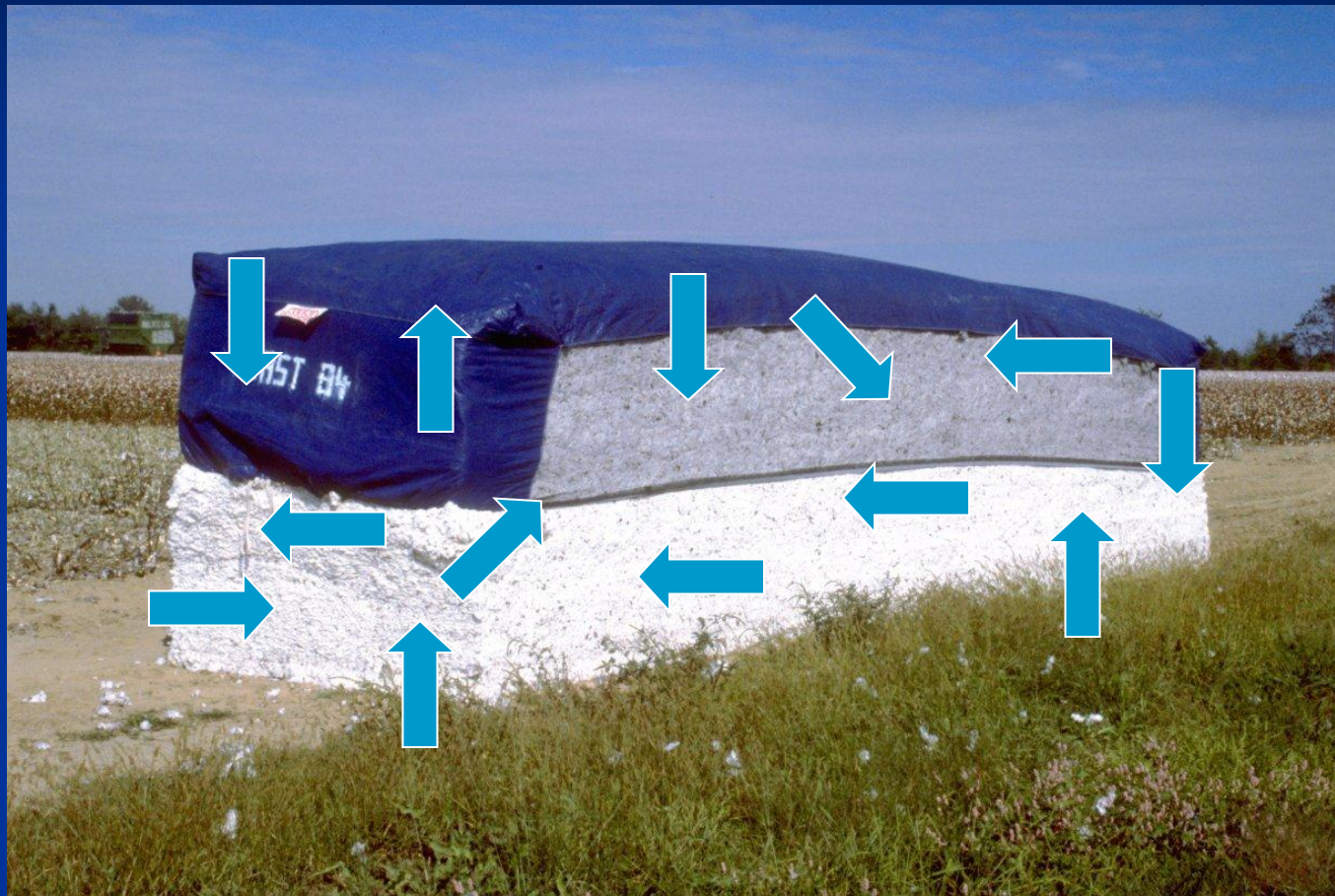
USDA studies have shown: The variability within a module is not significantly different than the variability within a bale.

BASIS: The averages of the measurements of length, strength, length uniformity, and micronaire in a module provide a sound statistical representation of each of the bale's individual measurements.
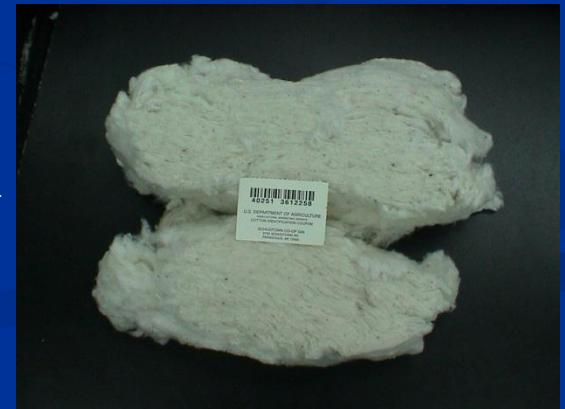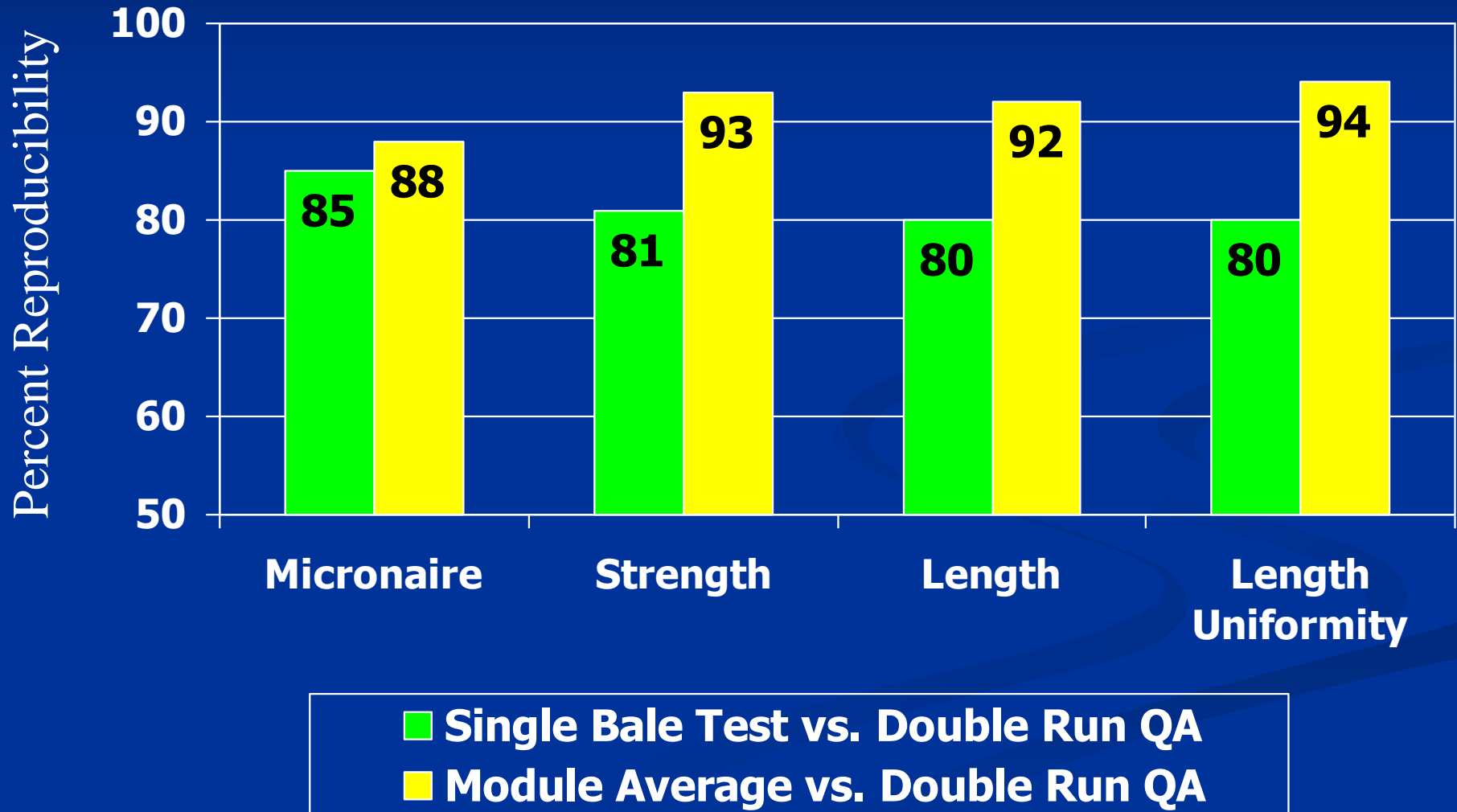
Per Cent and Total Participation US

Year	US %	Total Bales
2011	25.6	3.8 mil
2010	22.4	4.0 mil
2009	22.9	2.7 mil
2008	25.2	3.1 mil

Reproducibility: Single Bale vs. Module Average

Total Upland Average for 2008-2011

Chart: Percent Reproducibility by measurement category

- Micronaire: Single Bale Test vs. Double Run QA = 85, Module Average vs. Double Run QA = 88
- Strength: Single Bale Test vs. Double Run QA = 81, Module Average vs. Double Run QA = 93
- Length: Single Bale Test vs. Double Run QA = 80, Module Average vs. Double Run QA = 92
- Length Uniformity: Single Bale Test vs. Double Run QA = 80, Module Average vs. Double Run QA = 94

Legend:
- Single Bale Test vs. Double Run QA
- Module Average vs. Double Run QA

Reproducibility: Single Bale vs. Module Average
## *Pima Average for 2008-2011*
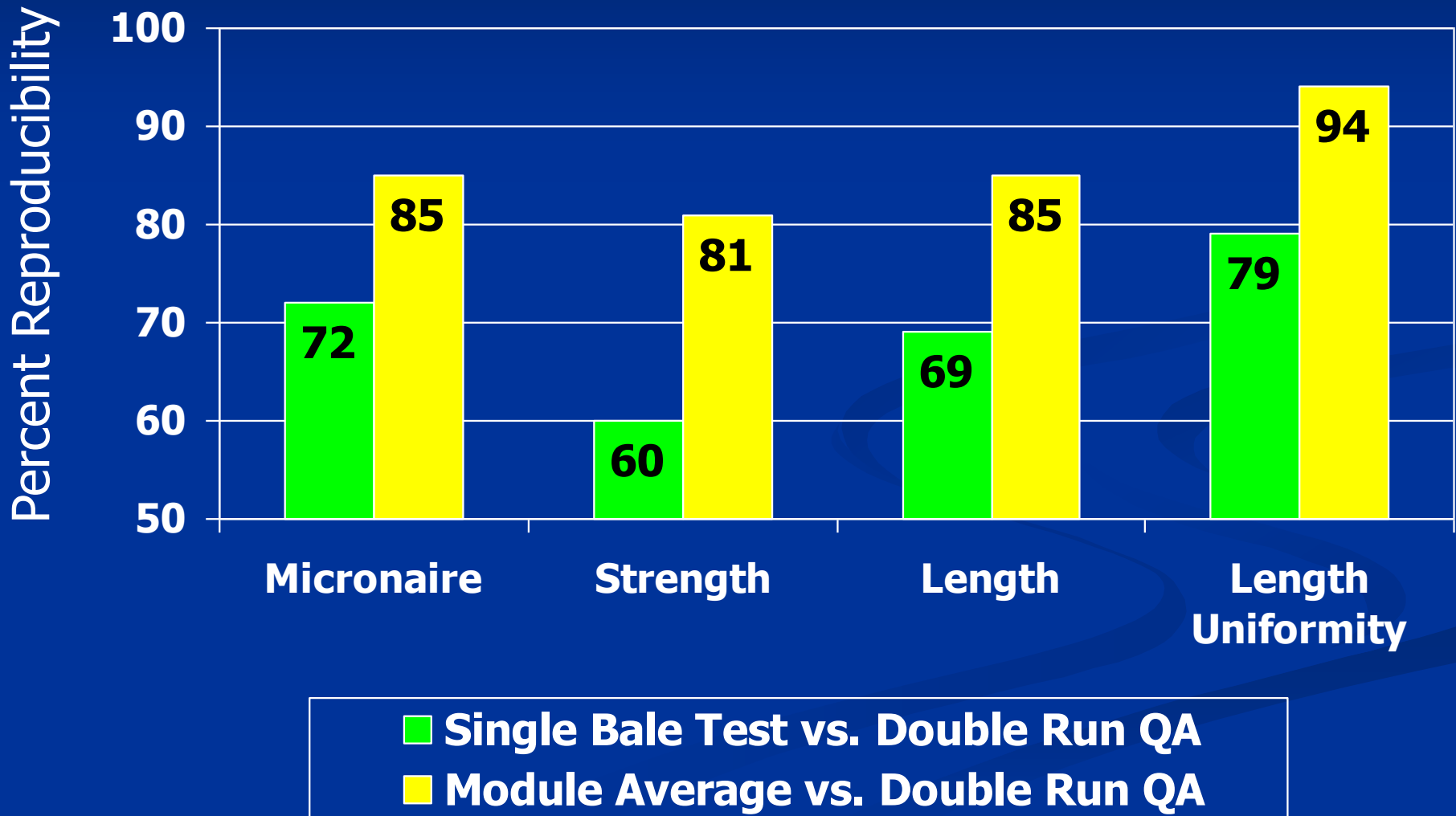
Comparison to Certificated Bales

- **PBI bale numbers submitted with certificated requests**

- **Compare Original Single Test to Cert. double test**

- **Compare Module Average to Cert. double test**

Reproducibility: Module Average Bales submitted for Cert. Class

Percent Reproducibility

- Micronaire: 86 / 96
- Strength: 81 / 96
- Length: 80 / 97
- Length Uniformity: 80 / 97
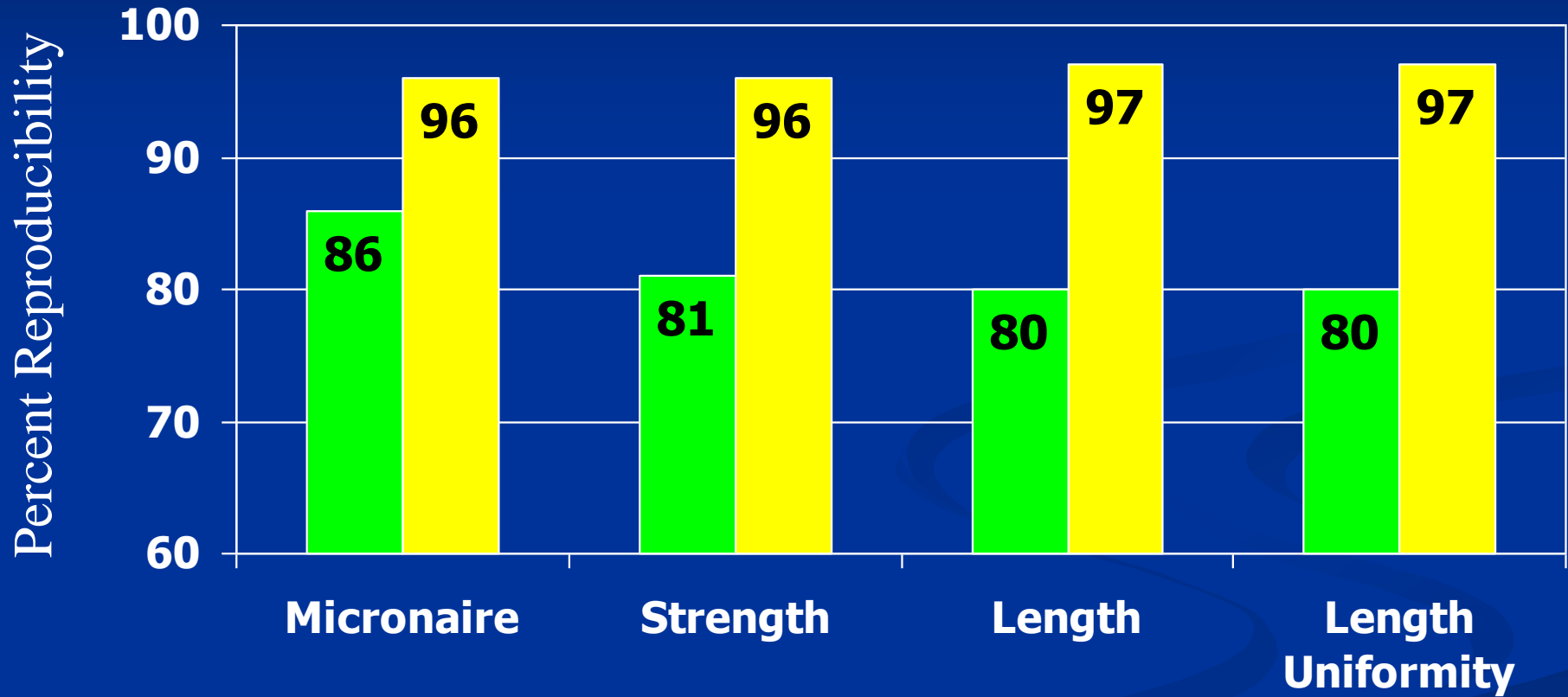
Single Bale Test vs. Double Run Cert.
Module Average vs. Double Run Cert.

Outliers

- After all bales in a module are averaged, any bales that have measurements outside of pre-established error tolerances are called "Outliers".

- Outliers represent a very small percentage of the overall bales that are module averaged (app. 1.5% in 2011; 1.3% in 2010; 1.2% in 2009; 1.2% in 2008)

- Historical studies over 20 seasons have shown that the majority of outliers move back to the module average within the acceptable testing tolerances when retested

  - This is even more true for middle bales (bales other than the first or last in a module)

Outliers

- Outliers are removed and the average of the remaining bales is re-calculated.

- The re-calculated module average is then assigned to all of the bales in the module including the outlier bales unless the outliers are first or last bales in a module or the total number of outliers exceed 20% of the total bales in the module.

- Each outlier bale not assigned the module average retains its original classification and can be submitted back to the Cotton Program for review class at no charge.

Module Averaging Example with Outliers

Length	Strength	Length Unif.	Mic.
1.11	28.9	83.2	5.1
1.13	**25.4**	82.6	4.9
1.14	29.3	83.4	4.6
1.11	27.8	84.1	5.0
1.14	31.6	84.0	5.0
1.13	31.9	83.5	4.9
1.13	30.2	84.6	4.8
1.14	31.4	83.7	4.9
1.14	30.1	83.8	4.7
1.13	31.4	82.9	4.9
1.14	31.9	83.2	**5.4**
1.17	30.9	83.7	4.8
1.14	30.0	83.3	4.6
1.14	29.4	82.8	4.6
1.13	29.9	84.2	4.8

Module Average Would Be:

LEN.	STR.	L.U.	MIKE
1.13	30.2	83.6	4.8

- Two outliers were present: 25.4 for strength and 5.4 for micronaire.

- They were removed and the remaining 13 bales averaged.

- All bales in the module were then assigned the averaged values.

Example 2

Module Average Would Be:

| Length	Strength	Len. Unif.	Mic.
1.08	30.3	81.8	5.2
1.10	29.0	82.6	5.0
1.13	30.4	83.2	5.1
1.12	30.2	83.4	5.1
1.11	28.4	83.1	5.2
1.11	28.4	82.5	5.2
1.09	28.3	82.7	5.0
1.07	30.4	82.2	5.2
1.11	28.2	83.0	5.2
1.12	29.0	83.3	5.1
1.15	30.6	83.1	3.8

LEN.	STR.	L.U.	MIKE
1.10	29.3	82.8	5.1

- The 3.8 Micronaire bale was an outlier.

- It was removed and the other bales averaged.

- All bales except the 3.8 bale were assigned the averaged values (last bale in module).

- The 3.8 micronaire bale retained its original values.

Study for 2011 - 2012

- **Adding color grade (Rd and +b)**
- **Adding leaf grade (percent area and particle count)**
- **Increasing number of bales allowed in average**
- **Additional safeguards for Outliers**
- **Comparison of conventional module variability to on board picker's modules**

Reproducibility: Color and trash within entire module
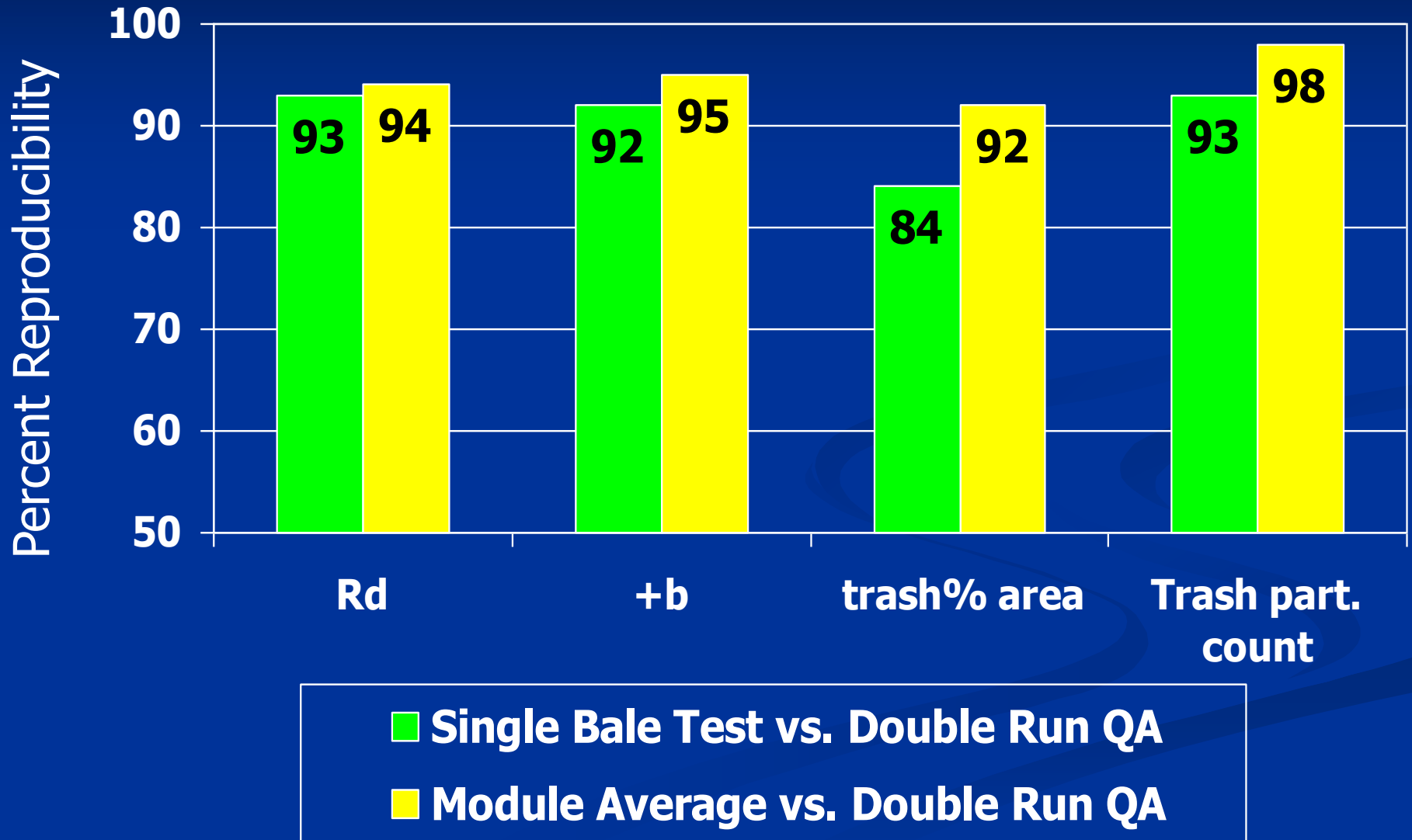
What are the Benefits (Value) to the Cotton Program?

- **First and foremost - improved accuracy in quality measurements to customers**

  - **More consistent**
  - **More reproducible and repeatable**
  - **Statistically reliable**
  - **More consistent for all data users**

What are the Benefits (Value) to the Cotton Industry?

Two Primary Benefits:

1. Data Accuracy and Reliability

- More accurate than single bale test
- Stands up to retesting upon delivery
- Holds up against scrutiny and challenge
- Added confidence to spinner in laydowns
- More reliable months later

What are the Benefits (Value) to the Cotton Industry?

2. **Positive Economic Value (on average)**

- Studies each year by the Cotton Program show overall positive economic result for module averaging

- Possible benefit to storing, staging and shipping bales

Conclusions

- History has proven that Module Averaging is a more accurate means for assigning classing data

- Module Averaging is supported statistically through 20 years of classing data plus value setting studies on calibration cotton

- It is statistically and economically beneficial

- Even though module averaging is actually more work for the Cotton Program, we truly believe it is the best method for the producer and for the industry