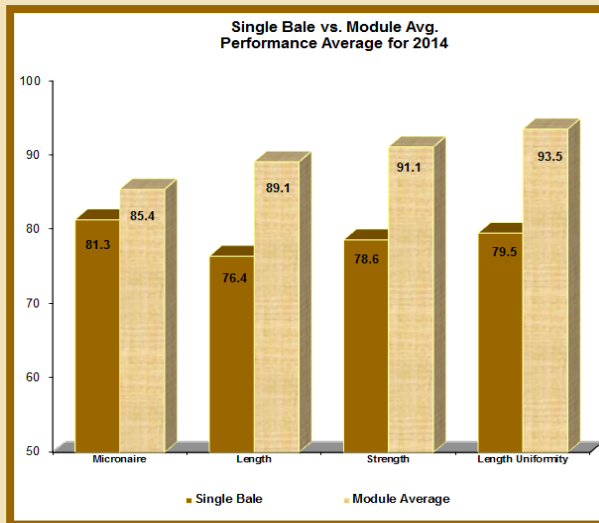## Benefits of Module Averaging

Cotton Industry:

- Improved accuracy in quality measurements
- Stands up to scrutiny, challenges and re-class both domestically and internationally
- Positive economic value (on average)
- Enhances storage, staging, and shipping options

USDA Cotton & Tobacco Program:

- Improved accuracy in quality measurements to customers ensuring classing data is more:
- Stable
- Reproducible and repeatable
- Statistically reliable
- Consistent for all data users
- Reproducibility = Repeatability
- Reduced Variability = Increased Accuracy and Precision
- Increased Accuracy & Precision = Increased Data Reliability, Confidence, and Marketing

Single Bale vs. Module Avg. Performance Average for 2014

	Single Bale	Module Average
Micronaire	81.3	85.4
Length	76.4	89.1
Strength	78.6	91.1
Length Uniformity	79.5	93.5

USDA **United States Department of Agriculture**

Module Averaging Program

Increasing Data Reliability, Confidence, and Marketability of *YOUR* Cotton

October 2015

Module Averaging

Module averaging is a voluntary program offered by USDA, AMS, Cotton and Tobacco Program since 1991 to all customers at no additional charge. It started as an effort between the USDA and an industry task group on quality to address a problem with the accuracy of the strength measurement. The success of the initial program led to the inclusion of micronaire, length, and length uniformity in 1992. These four measurements have been included in the module averaging program since.

Rules of Module Averaging

- Only factors of micronaire, length, strength, and length uniformity are averaged
- The maximum number of bales allowable for a module is 50
- Module averaged bales are HVI tested exactly as those not averaged
- Quality assurance testing rules apply to all bales whether module averaged or not
- After HVI testing all bales in a module, the individual values are collected and averaged
- Once averaged, the USDA computer calculates the differences from the average for each bale
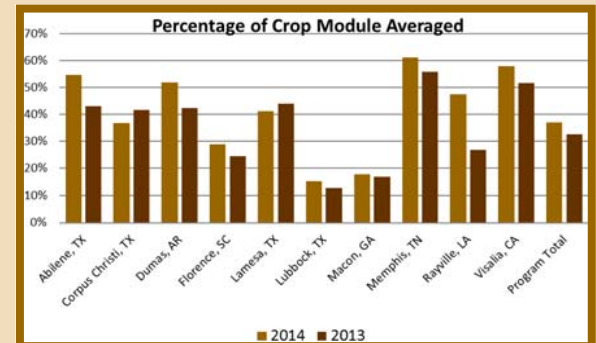- Any bales that have measurements outside of the pre-established module average tolerances are considered "Outliers"

Participation

If you are interested in participating, you should contact your gin or your local classing office. Be sure that the gin is in communication with the Cotton Program to ensure that the numbers and corresponding bale ranges are provided correctly and entered into the system. Feel free to contact your local classing office Area Director with any questions.

Applying Economic Impact to Entire Upland and Pima Crop - All Offices

| | Points | | | | | Avg. Gained per | Bales Module | Total Gained for | Total Bales | Est. Gain if all Bales |
	Length	Mike	Strength	Uniformity	Total	500 lb. Bale	Averaged	Module Avg. Bales	Classed (5/22)	Module Averaged
Florence	6.6	3.1	1.9	3.8	15.4	$ 0.77	458,859	$ 353,321.43	1,684,745	$ 1,297,253.65
Macon	7.9	5.7	3.3	3.9	20.8	$ 1.04	534,467	$ 555,845.68	3,115,116	$ 3,239,720.64
Rayville	5.5	7.6	0.8	3.2	17.1	$ 0.86	203,017	$ 173,579.54	429,911	$ 367,573.91
Dumas	5.1	6.3	1.8	2.3	15.5	$ 0.78	498,668	$ 386,467.70	981,693	$ 760,812.08
Memphis	4.7	5.0	1.5	1.9	13.1	$ 0.66	1,233,114	$ 807,689.67	2,040,093	$ 1,336,260.92
Abilene	3.3	3.3	1.0	2.6	10.2	$ 0.51	550,020	$ 280,510.20	1,042,240	$ 531,542.40
Corpus	4.4	3.2	1.7	2.8	12.1	$ 0.61	628,803	$ 380,425.82	1,748,541	$ 1,057,867.31
Lubbock	3.6	1.9	1.3	3.3	10.1	$ 0.51	326,150	$ 164,705.75	2,528,493	$ 1,276,888.97
Lamesa	4.5	2.9	0.9	4.1	12.4	$ 0.62	424,092	$ 262,937.04	1,045,647	$ 648,301.14
Visalia	4.6	3.1	0.7	2.6	11.0	$ 0.55	385,874	$ 212,230.70	720,696	$ 396,382.80
Upland Total	5.0	4.2	1.6	2.9	13.6	$ 0.68	5,243,064	$ 3,577,713.52	15,337,175	$ 10,912,603.80
Visalia Pima	2.4	3.4	5.3	0.0	11.1	$ 0.56	306,983	$ 170,375.57	544,691	$ 302,303.51

Source: USDA Cotton and Tobacco Program.

Percentage of Crop Module Averaged

■ 2014   ■ 2013

When Bales are Flagged as Outliers

Historical studies since 1992 have shown that the majority of outliers move back to the module average within acceptable testing tolerances when retested. The AMS Cotton Program's classification system has a series of internal checks and retest parameters to ensure the accuracy of classification data. If an outlier occurs, the following steps take place:

- Each outlier bale is removed from the module average calculation
- The average for the remainder of the bales in the module is recalculated
- The recalculated module average (minus the outlier) is then assigned to all of the bales in the module except those where outlier exclusions apply
- The module average is not assigned to any first or last outlier bales in a module. Those bales retain their original values. In most instances, middle bale outliers will receive the recalculated module average
- Studies have shown that first and last bales in modules have a higher probability to be true outliers than middle bale outliers
- The USDA will review the class of any outlier bale at no charge that retains its original value that is submitted back to them. The policy has been in effect since the inception of module averaging

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.

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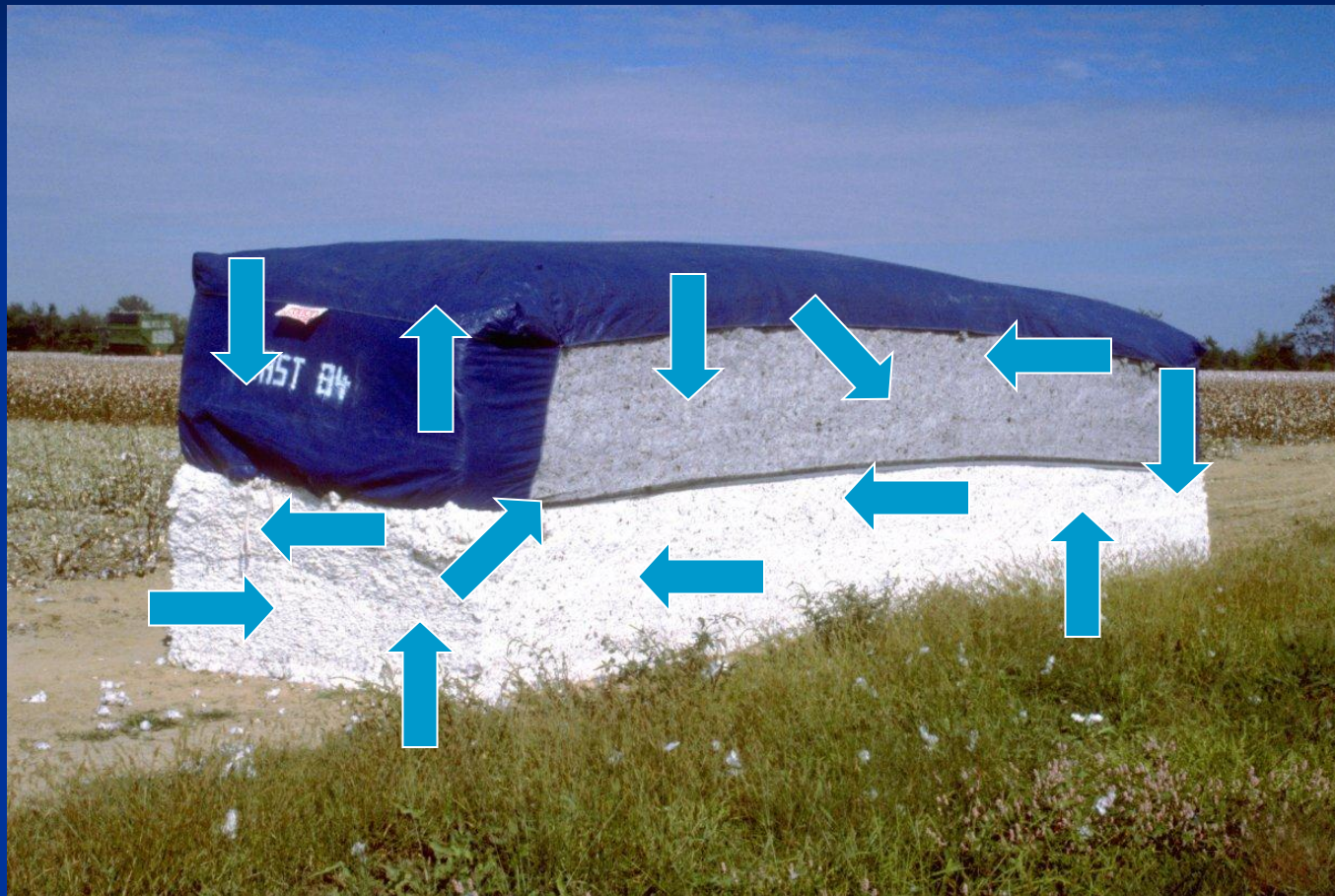
USDA studies have shown: The variability within a module is not significantly different than the variability within a bale.

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.**

Reproducibility: Single Bale vs. Module Average

Total Upland Average for 2008-2011

Percent Reproducibility

Micronaire	Strength	Length	Length Uniformity
85 / 88	81 / 93	80 / 92	80 / 94

■ Single Bale Test vs. Double Run QA
■ Module Average vs. Double Run QA
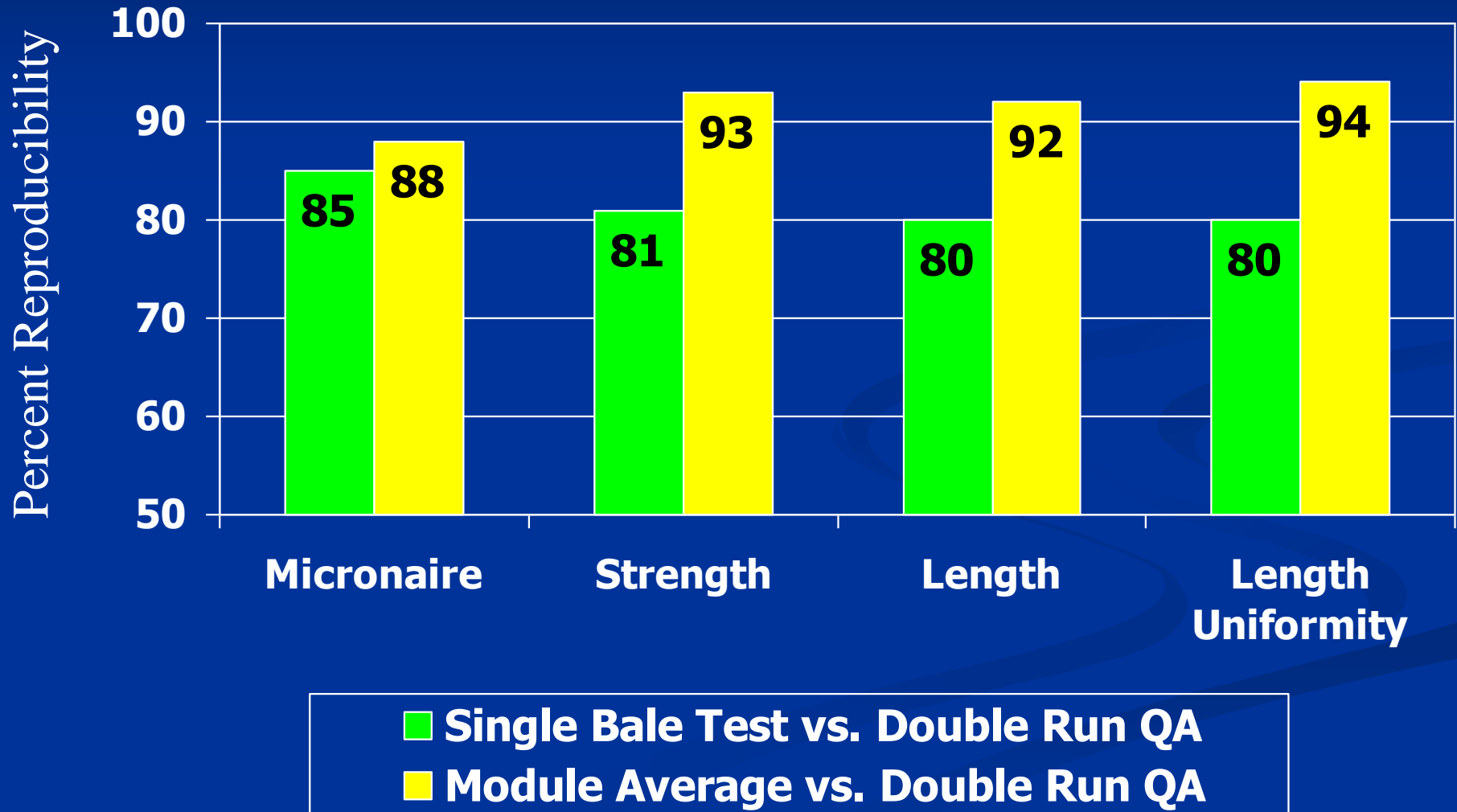
Outliers

- 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.

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