

Effects of Heat Stress on Cotton Production in the Low Deserts of Arizona

Dr. Randy Norton

Extension Agronomist

The University of Arizona

2020 Fall Virtual Field Day

Blase Evancho, Parker Robinson, Kaleb Bryce, Naomi Pier

Rayner Field Day – University Variety Trial

- **Virtual**
 - **Some time in November**
 - **Perhaps right after Thanksgiving**

Arizona Cotton Production

- **Characterized by hot, dry climate**
 - High yield potential
 - Relatively low disease pressure
- **Seed production**
 - Observed effects on fruiting patterns on new un-tested varieties
 - Observed correlations to L2 heat stress events

Heat Stress in Cotton

- **Brown and Zeiher (1998) - Documented other floral abnormalities**
 - **Smaller flowers**
 - **Asynchronous development of male and female structures**
 - **Failure of anthers to release pollen (indehiscence)**
 - **Presence of elongated stigmas and shortened anthers/filaments**

Cotton Heat Stress

- Well characterized by Crop Canopy Temperature (CCT)
- Crop Canopy Temperature (CCT)
 - L1 heat stress: 82.4°F – 86°F
 - L2 heat stress: greater than 86°F
 - CCT calculated based upon AT, RH, VPD
 - Correlation between calculated and measured
 - <https://cals.arizona.edu/azmet/cot-HSrpt.htm>

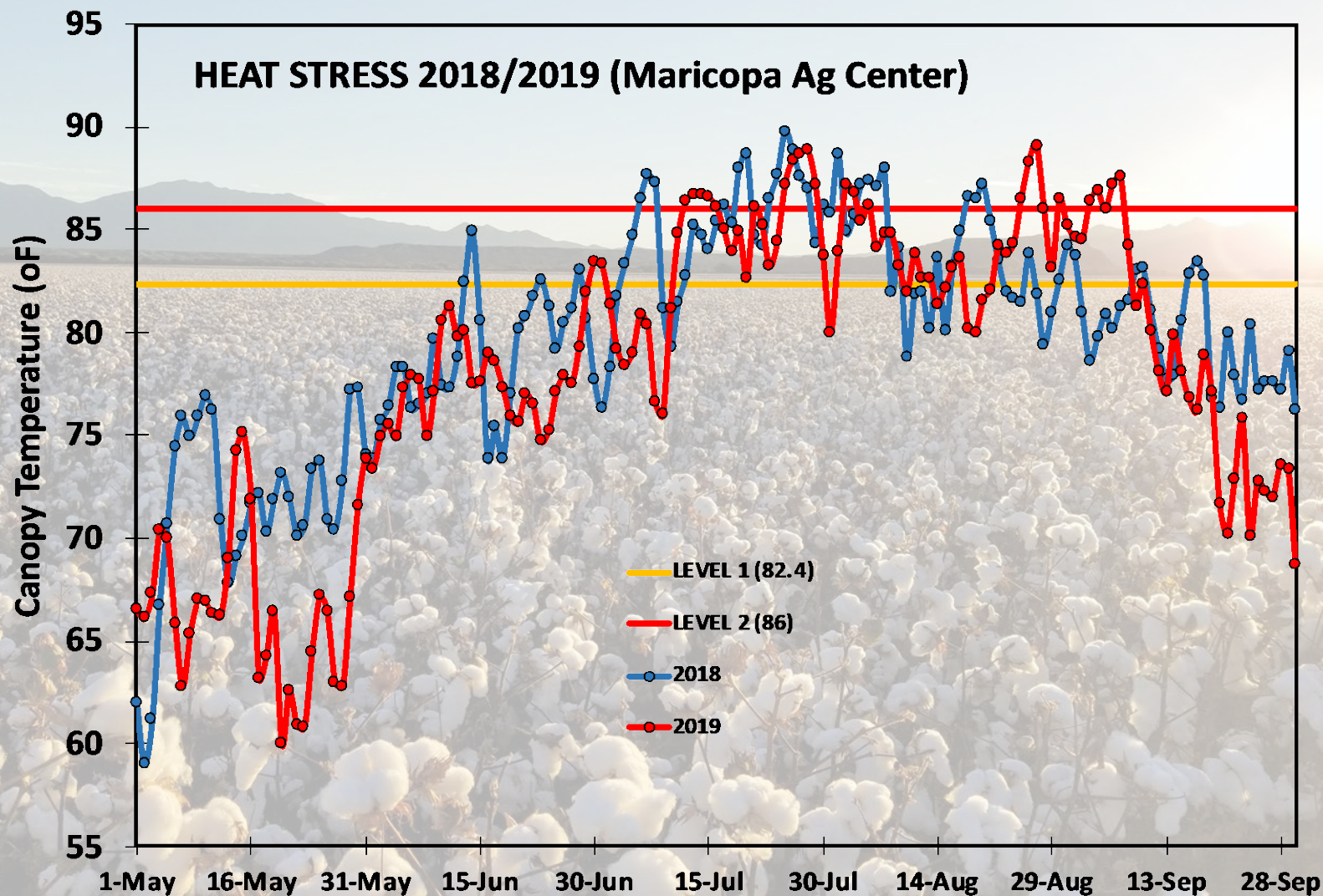
Objectives

- **Establish protocol for in-field measurements to determine a specific cultivars' ability to tolerate heat stress**
 - **Correlation of observations to meaningful outcomes**
 - Seed set/production
 - Fruit retention
 - Yield

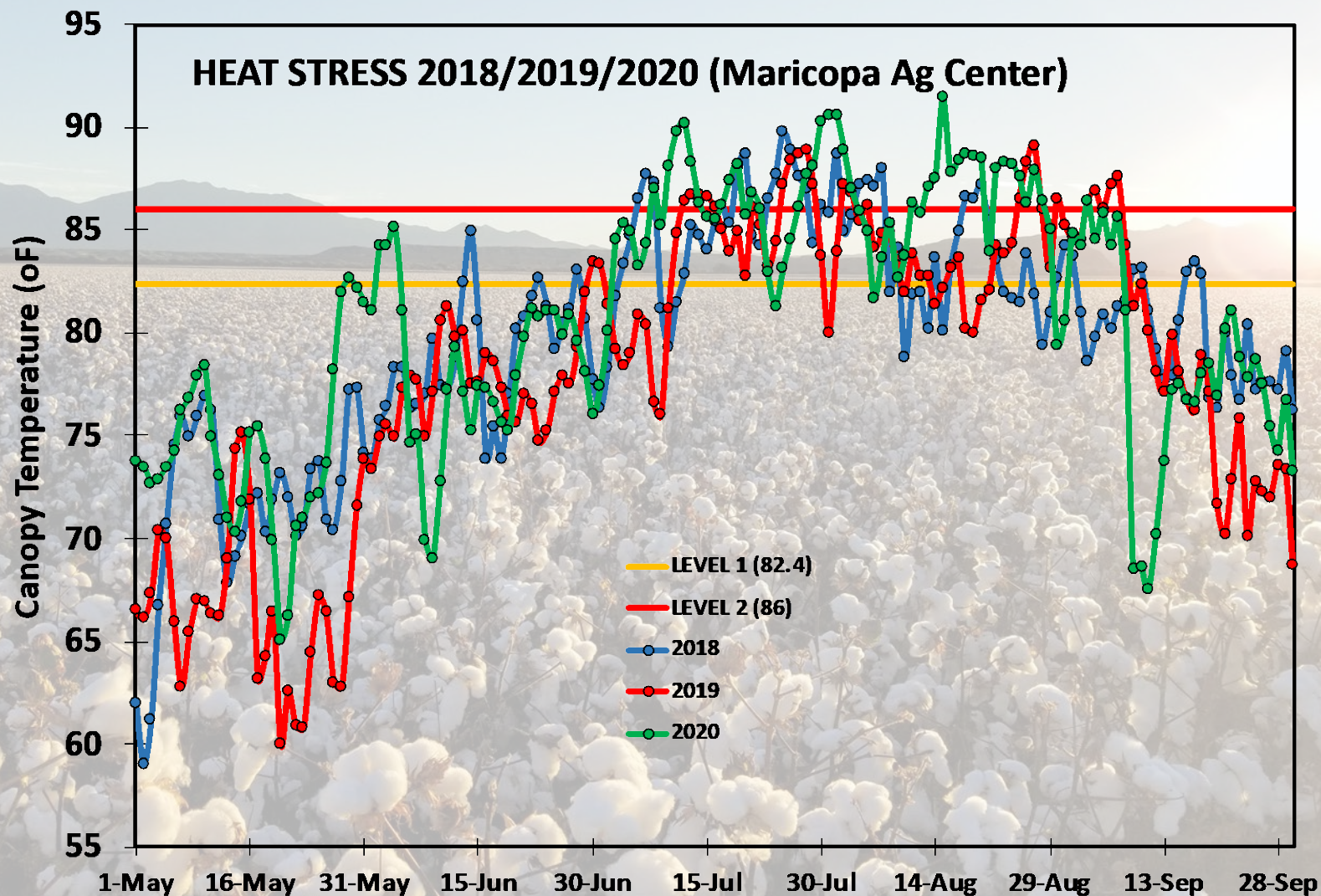
2019-2020 Heat Stress Evaluation Protocol

- **Maricopa Ag Center - 2020**
 - **Flower and Fruit**
 - Pollen dehiscence
 - Flower morphology
 - Abortion/Cavitation – plant mapping
 - Incidence of abnormal bolls
 - Flower tagging – follow through to boll development (percent retained and symmetry)
 - **Seed and yield**
 - Seed count – seed per boll
 - Seed index – grams per 100 seed
 - Lint Yield
- **Evaluate commercial controls (DP1044B2RF and DP1549B2XF)**
- **39 Entries – same entries as UCAST at Maricopa**

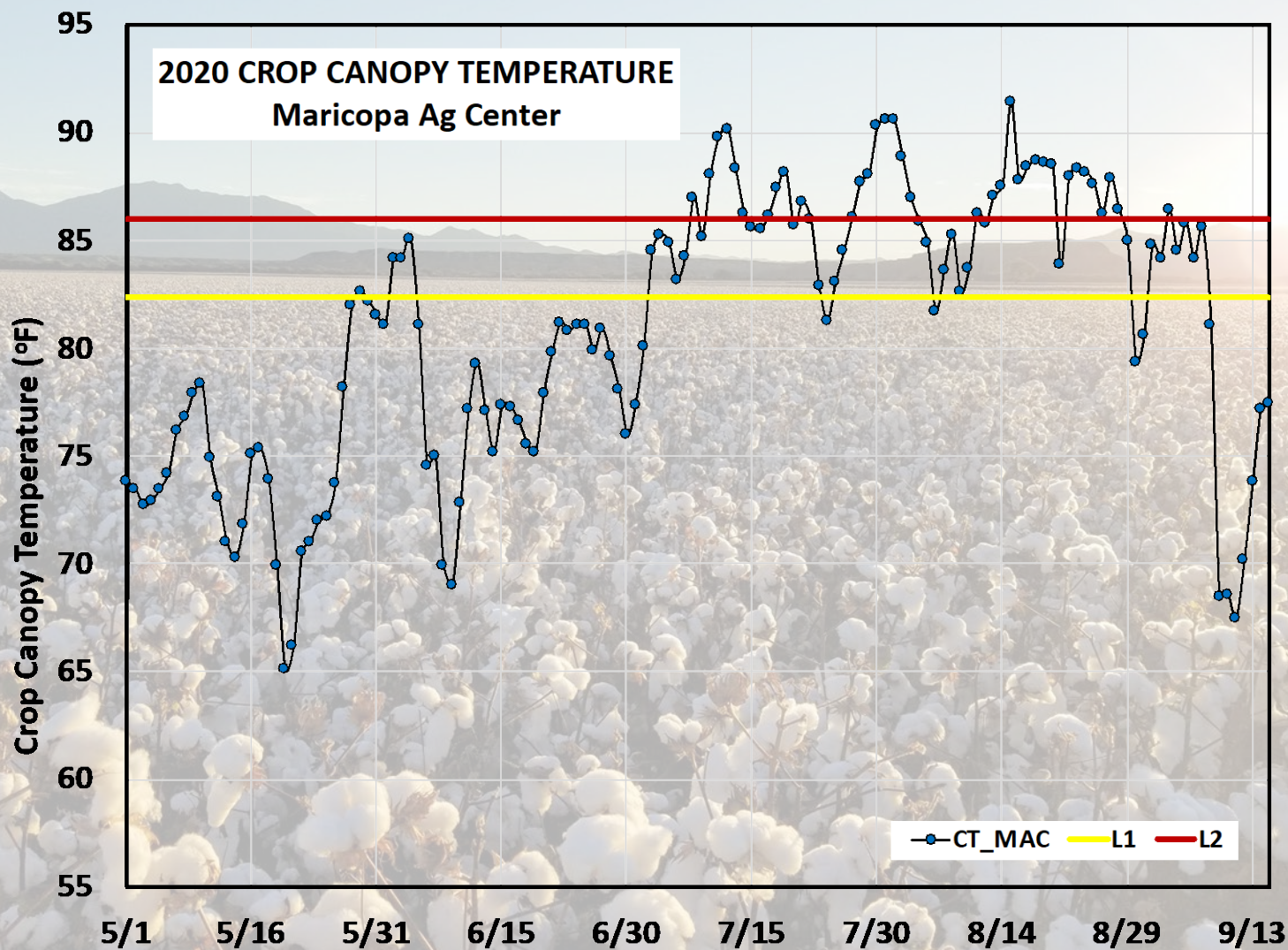
CCT Maricopa – 2018/2019/2020



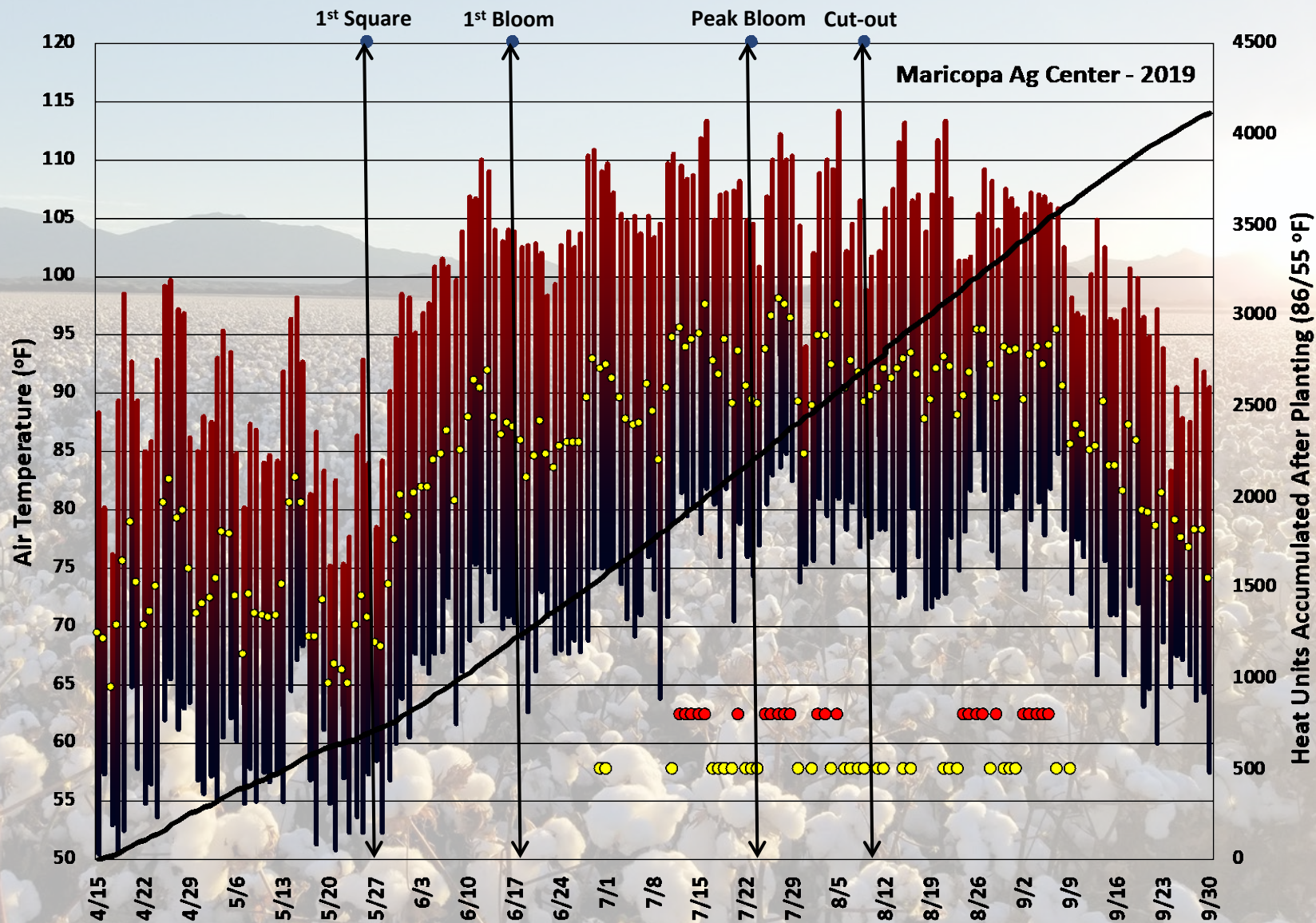
CCT Maricopa – 2018/2019/2020



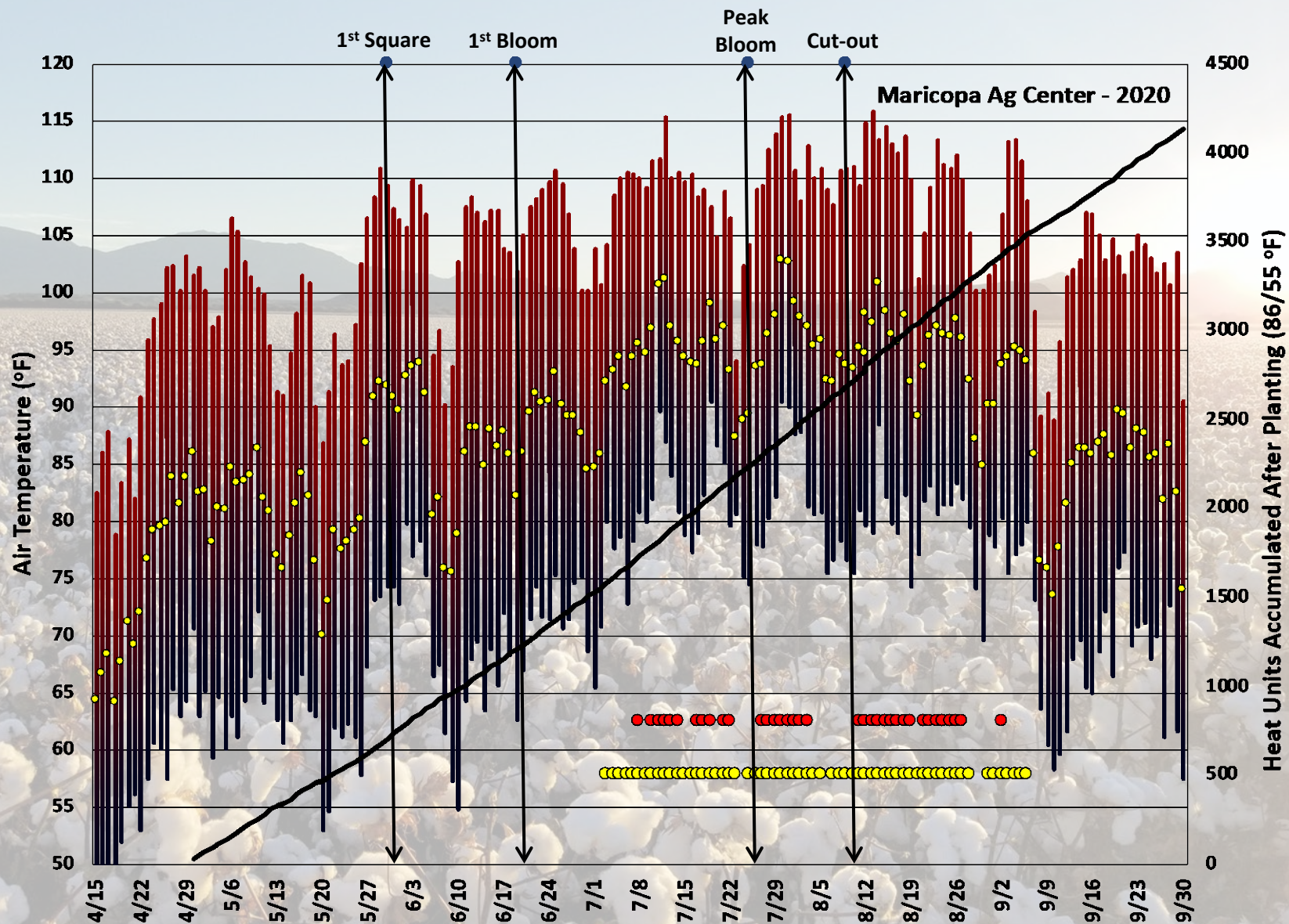
CCT Maricopa – 2020



Heat Stress – Maricopa 2019



Heat Stress – Maricopa 2020



Flower Morphology

- Flowers given a rating of 1-5
 - Dependent upon separation of female and male floral components

2

3

5



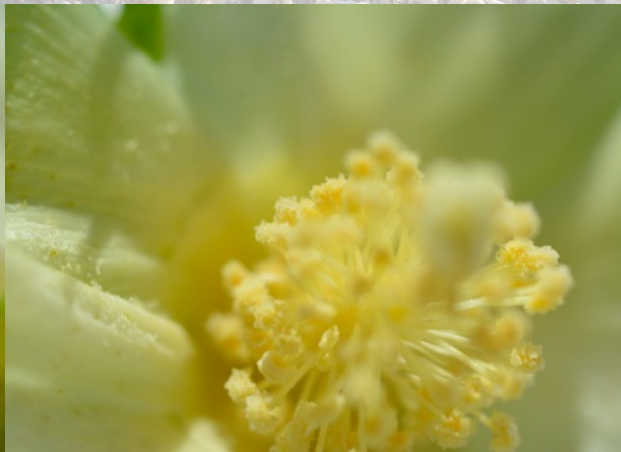
Pollen Dehiscence

- Flower given a rating of 0-4
 - Dependent on level of pollen dehiscence

0

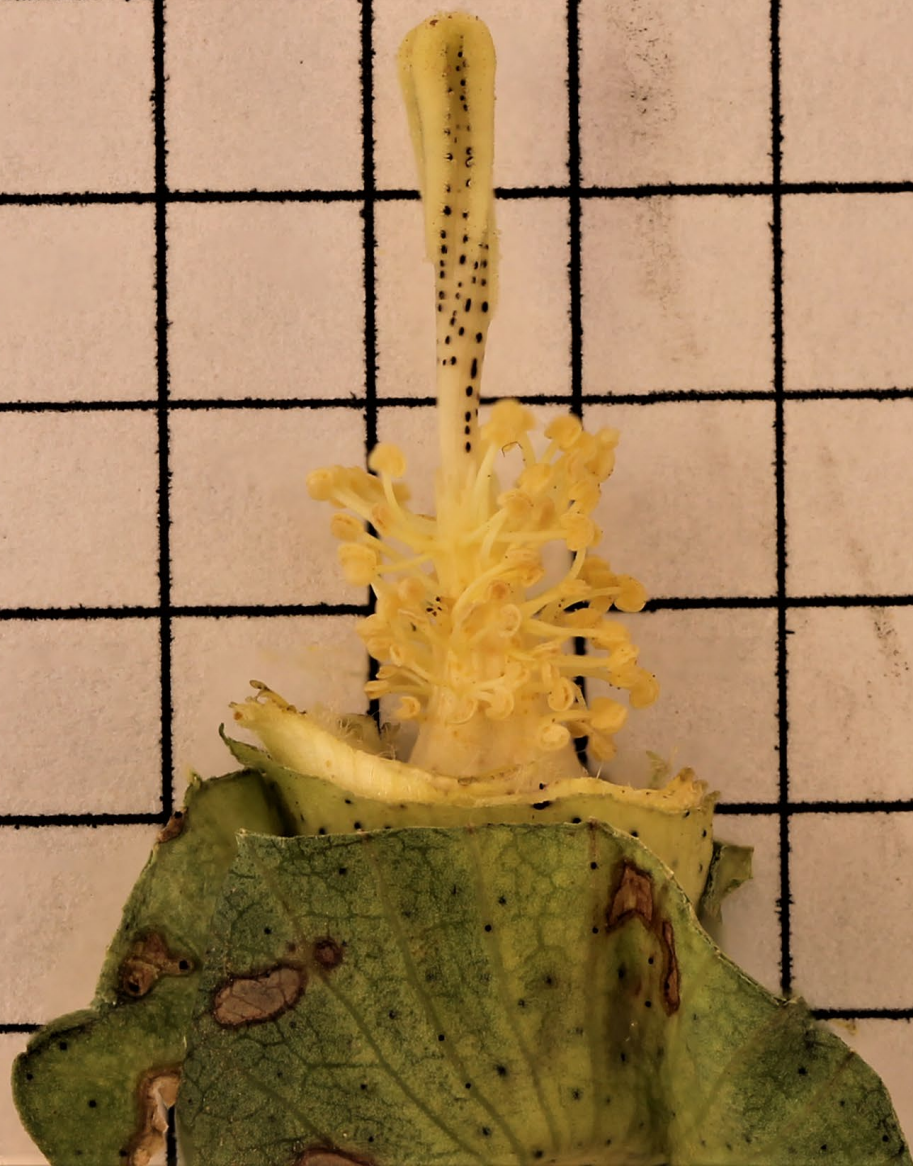
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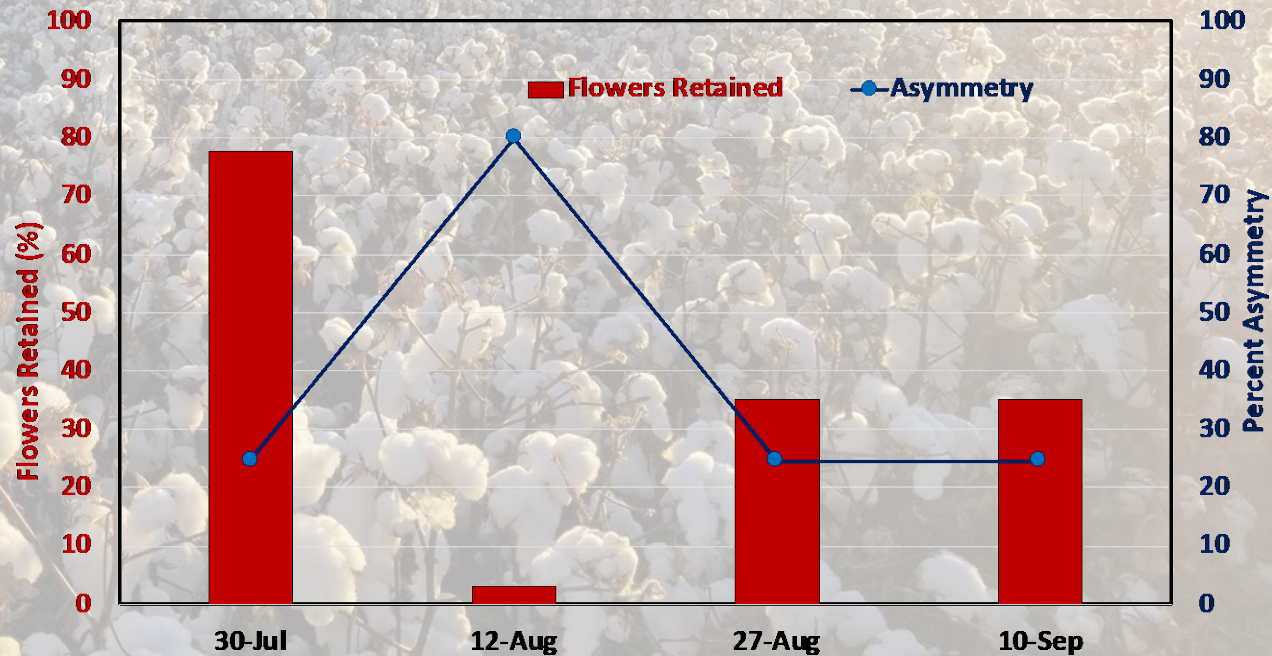
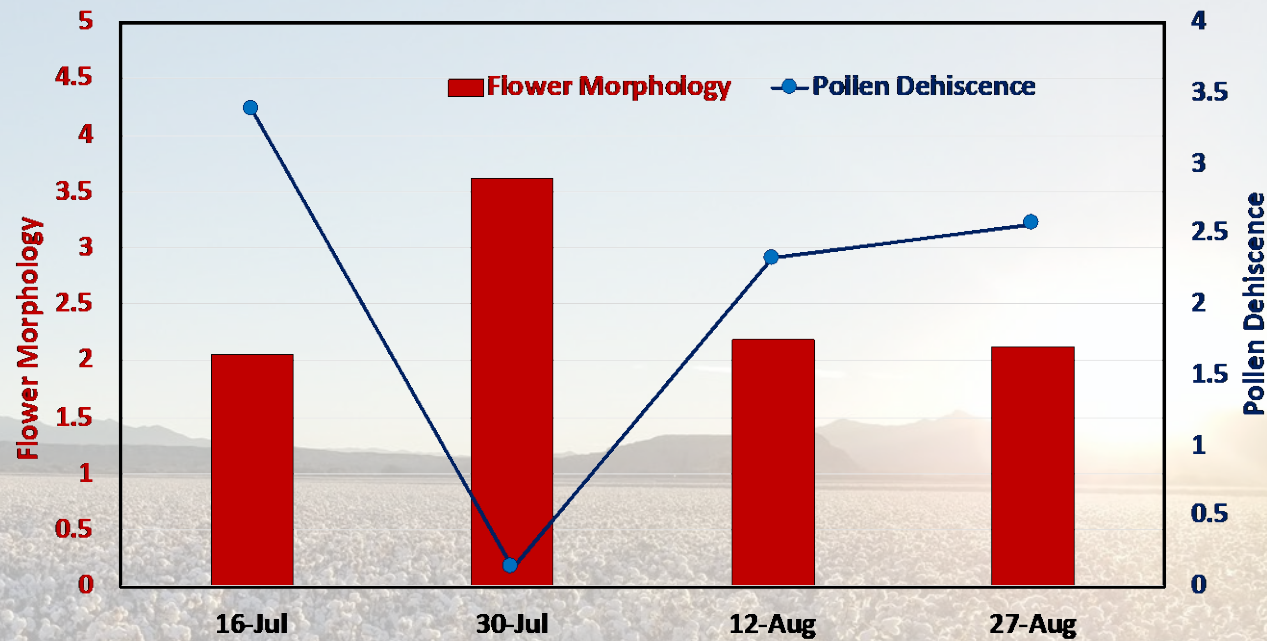








Fruit Data Summary





2019 data still yet to come for 2020

Final Plant Map

Percent Retention

Mean	Std Dev	Maximum	Minimum
47.1	10.8	23.5	65.8

Height to Node Ratio

Mean	Std Dev	Maximum	Minimum
1.4	0.2	2.0	1.1

Mainstem Nodes

Mean	Std Dev	Maximum	Minimum
26.8	1.7	22.8	30.4

Percent Asymmetrical Bolls

Mean	Std Dev	Maximum	Minimum
29.3	15.6	67.6	2.9

Seed and Yield Data

Percent Lint

Mean	Std Dev	Maximum	Minimum
0.42	0.02	0.46	0.36

Seed Index (g/100 seed)

Mean	Std Dev	Maximum	Minimum
9.6	0.9	11.5	8.0

Seed weight per boll (g)

Mean	Std Dev	Maximum	Minimum
2.1	0.3	2.8	1.4

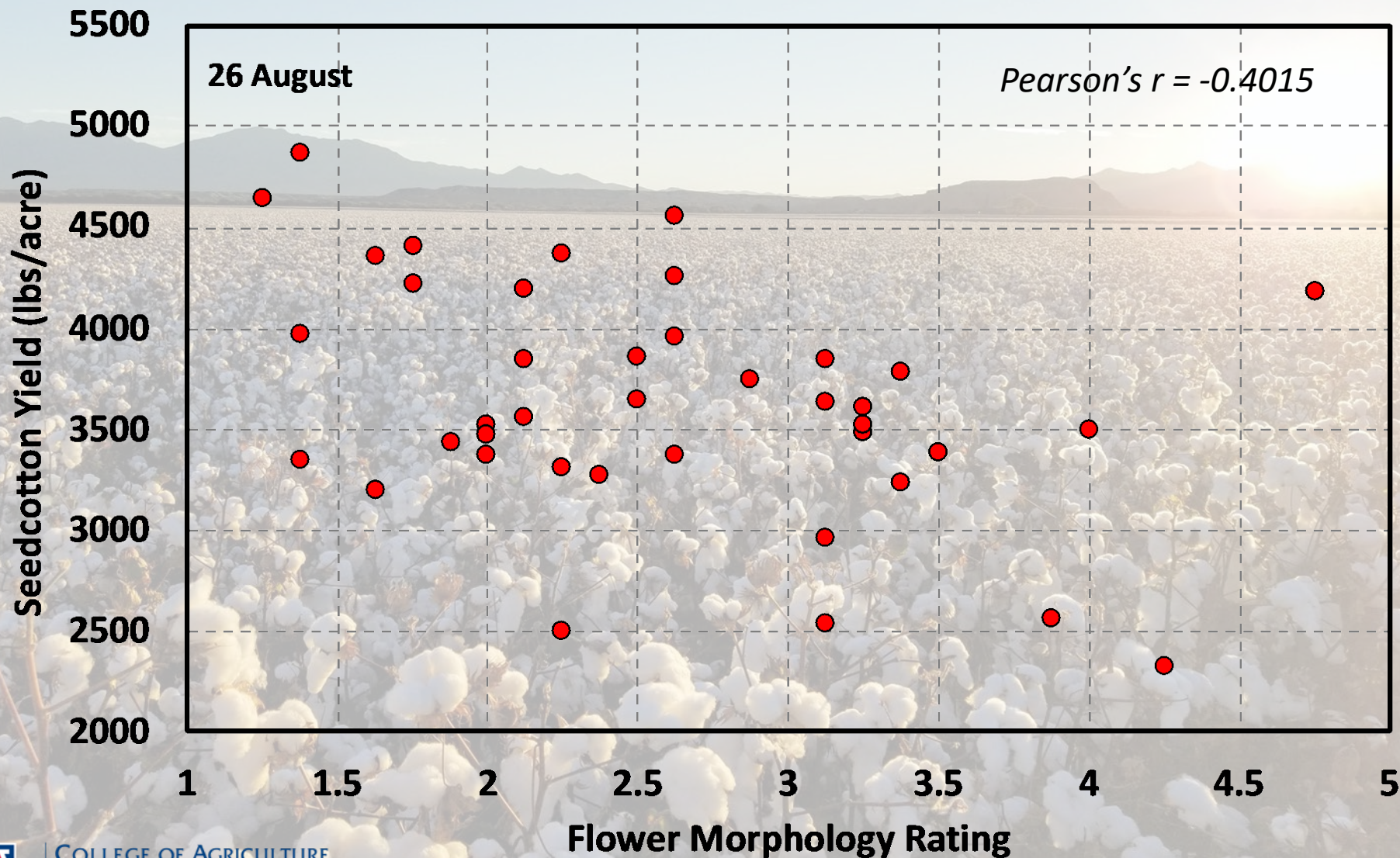
Number of seed per boll

Mean	Std Dev	Maximum	Minimum
21.6	2.8	26.3	15.9

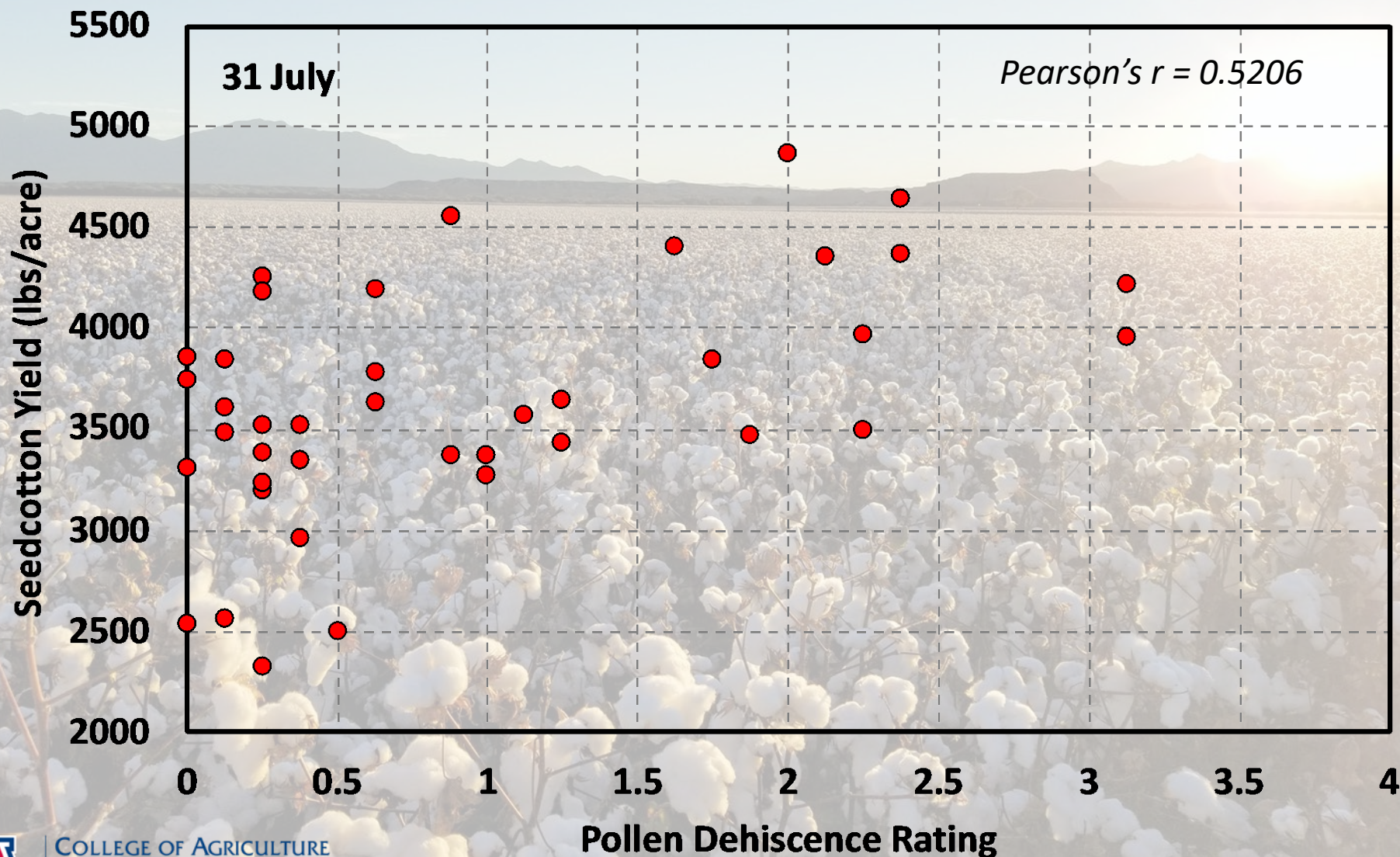
Seedcotton Yield (lb/acre)

Mean	Std Dev	Maximum	Minimum
3668.3	604.5	4865.9	2321.6

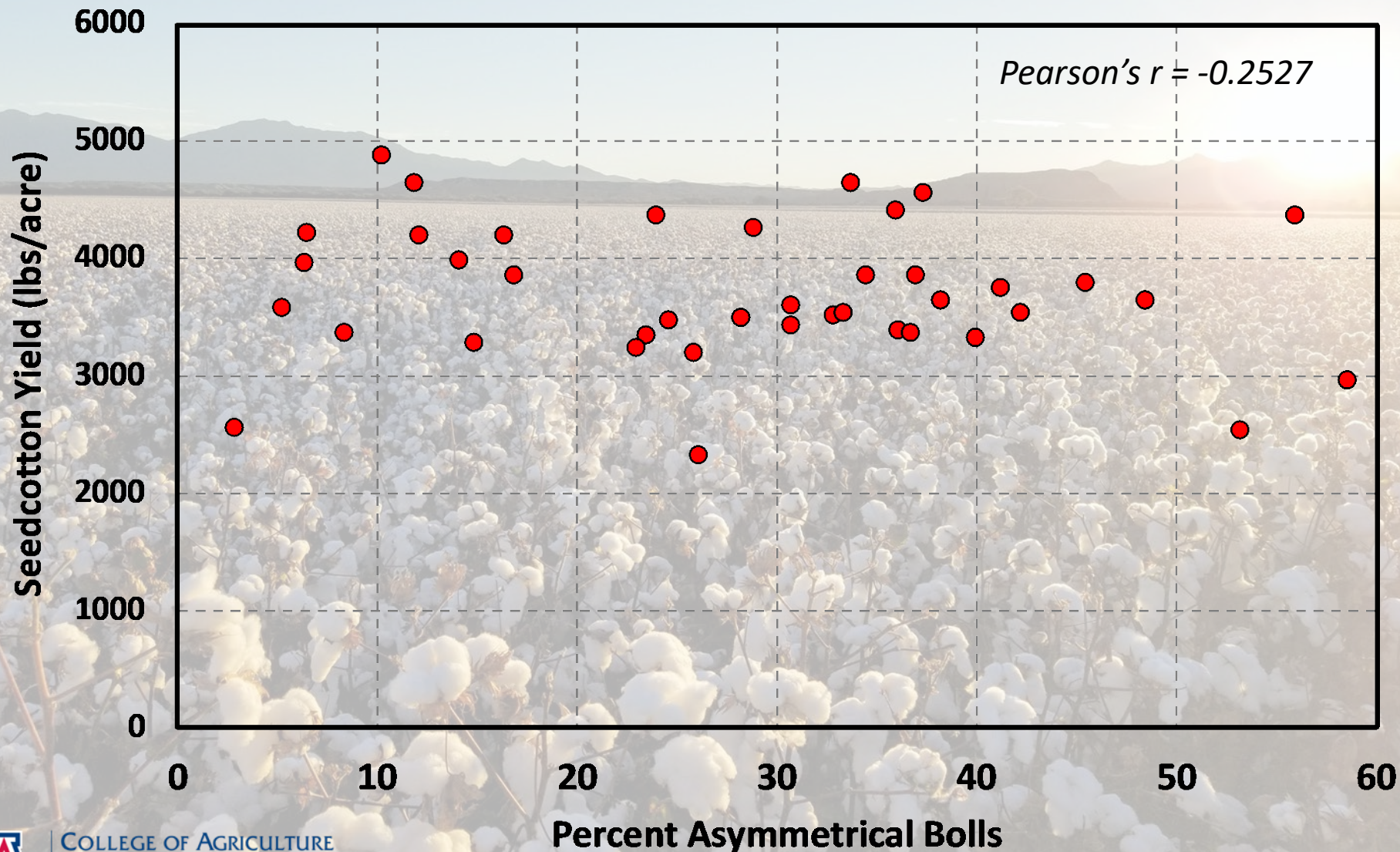
Flower Morphology – 26 Aug



Pollen Dehiscence – 31 Jul



Asymmetrical Bolls



Conclusions – 2019

- **Variability among varieties with respect to:**
 - Flower morphology
 - Pollen dehiscence
 - Seed attributes
 - Final Plant Map
 - Yield
- **Poor to moderate correlation among measured values to yield**
- **Many more factors controlling yield than just heat tolerance**
- **Relatively low heat stress year – no extended periods of L2 heat stress**
 - Not a representative year for heat stress effects

Conclusions – 2020

- **Variability among varieties with respect to:**
 - Flower morphology
 - Pollen dehiscence
 - Seed attributes
 - Final Plant Map
 - Yield

Moving Forward...

- **Need for additional years of evaluation**
 - Capture variability in heat stress years
- **Flower tagging**
 - Follow an evaluated bloom to determine fate
- **Funding and support**
 - **Participating seed companies:**
 - Bayer
 - BASF
 - Corteva
 - Americot