Update on Cotton Genetics Program

Shafter Cotton Research Station

Objectives

- **Development of Cotton Germplasm with improved disease resistance to Fusarium wilt (FOV)] and improved fiber quality**
- **Identification and validation of molecular markers to study the cotton genome**

Host Plant Resistance

1. **The Defense Mechanisms of Plants Against Fungi, Nematodes or Insects.**

1. **Genetic Makeup of Plants.**

1. **Typically the most Economical Method of Crop Protection.**

FOV Plant Symptoms:

- Wilting, yellowing, and necrosis of leaves.
- Internally, the xylem is dark brown [vascular root staining (VRS)].

Greenhouse Test

Seeded RIL Population

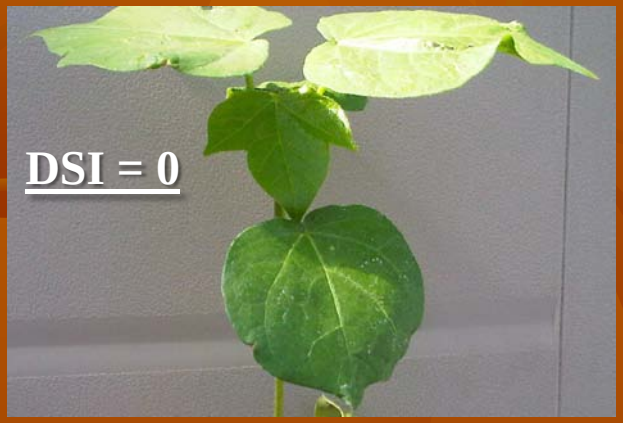
race 1 FOV Seedling Inoculation

race 1 FOV infection days after Inoculation (dai 18)

Plant Infection

Resistant < 2.0 & Susceptible > 2.0

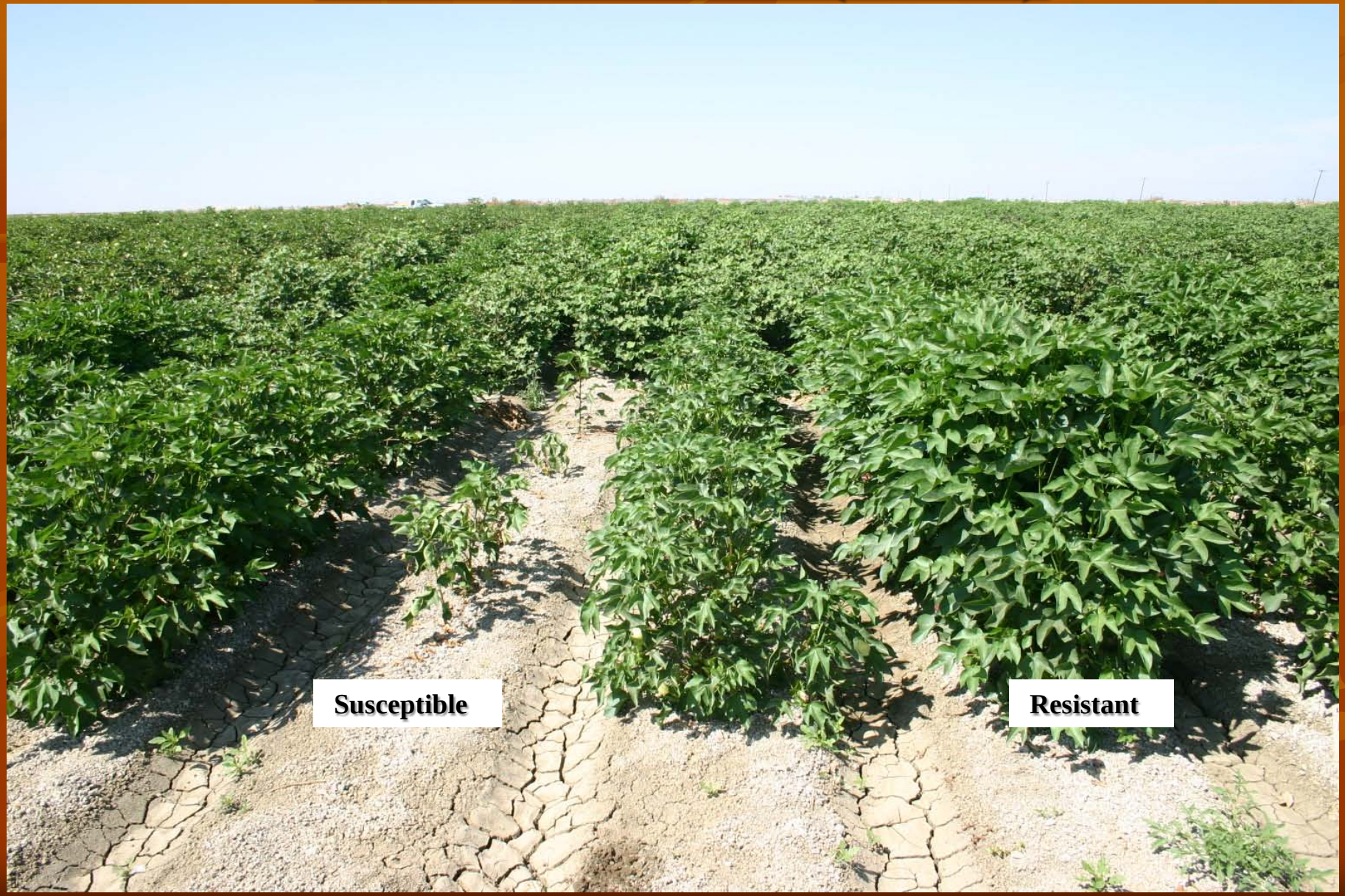
Disease severity index (DSI) of leaves, (scale 0 – 5)



Vascular stem and root staining [VRS (scale 0 - 5)]

Field Assay

Fusarium wilt (FOV)



EVALUATION FOR RESISTANCE TO FOV 2003 - 2010

- Greenhouse Evaluation
  - FOV races 1 & 4
- Field Evaluations
  - FOV race 1 & co-infested with root-knot nematodes (RKN)
  - FOV race 4

More than 17,000 plants have been assayed in multiple greenhouse and field evaluations representing more than 1000 progeny of selected crosses, germplasm lines, and commercial cultivars.

FOUR PIMA GERMPLASM LINES JOINTLY RELEASED BY USDA-ARS, UNIV. OF CALIFORNIA, & UNV. OF NEW MEXICO

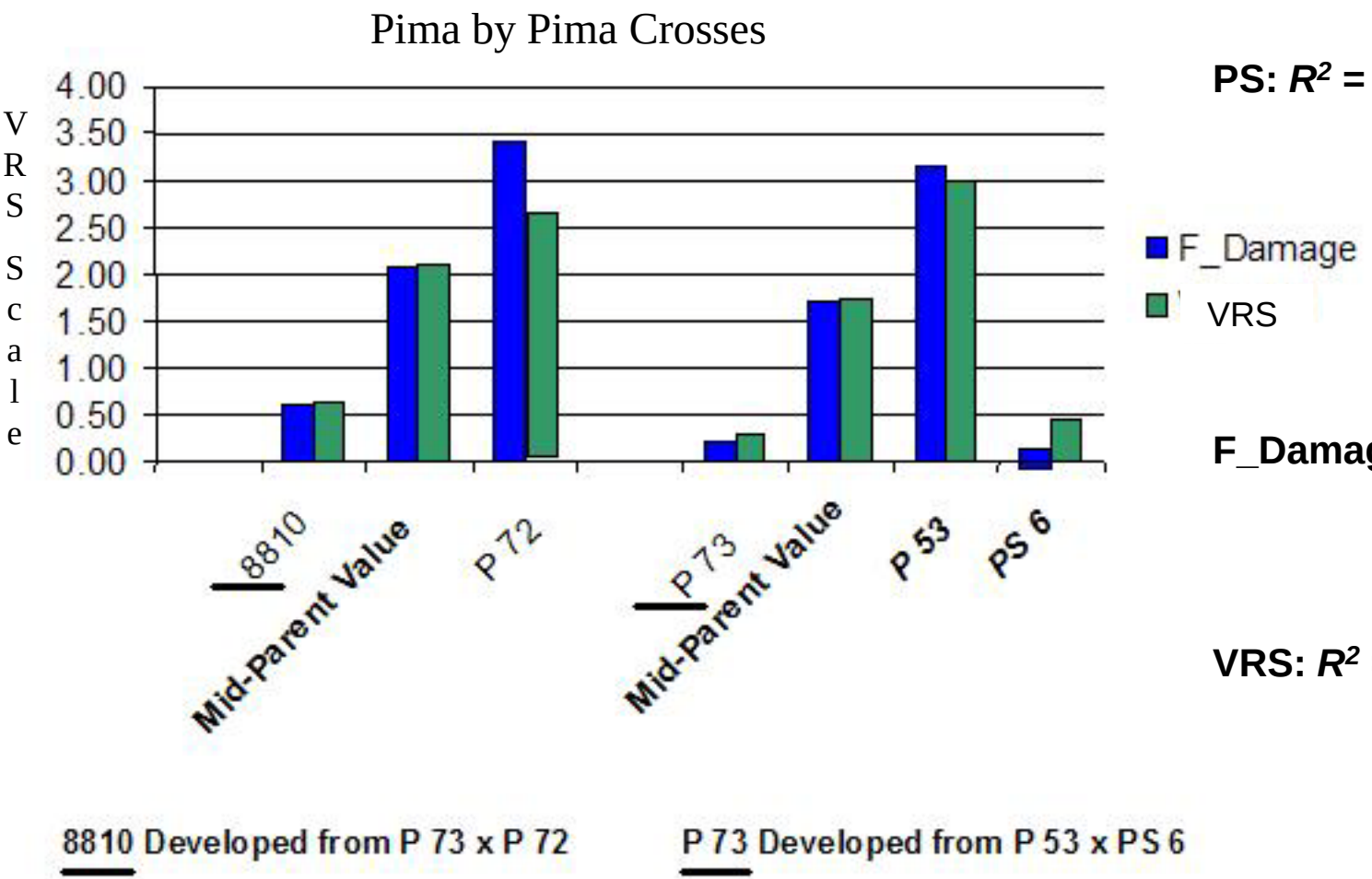
- SJ-07P-FR01
- SJ-07P-FR02
- SJ-07P-FR03
- SJ-07P-FR04

- Continuing efforts for Releasing additional Germplasm with improved Yield, Fiber, and Pest Resistance
- Ulloa et al., Journal of Plant Registration. 3: 198-2010. 2009

Inheritance FOV

Race 4 FOV Inheritance

Ulloa et al., *Journal of Cotton Science. 10:114-127. 2006*



PS: R^2 = 0.56 &

h^2 = 0.61

F_Damage: R^2 = 0.58 &

h^2 = 0.64

VRS: R^2 = 0.63 &

h^2 = 0.70

Race 4 FOV Inheritance

Resistant & Susceptible

Resistant & F_1 Progeny

FOV Summary

- **Evaluations:**
  - **Evaluations between the two FOV races (1 & 4)**

Plant observed with different levels of FOV infection and survival rates.

- **The host plant resistance observations may suggest additional gene(s) for mechanisms of plant response for FOV race 1 and race 4.**

Molecular Breeding for Disease Resistance to Fusarium Wilt (FOV) races 1 and 4 in Cotton

- Approximately 1200 molecular markers located on different cotton chromosomes were analyzed, and continue to be analyzed in different mapping populations from crosses of Upland-by-Upland, Upland-by-Pima, and Pima-by-Pima cottons.

SUMMARY

- Pima cottons were observed to be more susceptible to FOV race 4 (stand loss, stunting, etc) than any Acala or Upland cottons
- However, Preliminary results showed that Pima resistant germplasm has a more complete resistance to FOV race 4.
- The impact of the disease for Acala and Upland cottons for stand loss and stunting was milder than the effects on Pima, but still a problem.
- However, Acala as well as Upland cottons were infected by FOV race 4 up to levels that cultivars could reproduce and expand inoculum.

Mapping Fusarium wilt (FOV) race 1 resistance genes Summary

- A set of 24 SSR markers indicated gene interactions and inheritance from nine cotton chromosomes, with major QTLs detected on five.

- The single recessive gene (*Fov1*), previously identified in F_2 (Pima-S7x NemX) population, and the AFLP markers were mapped and co-located with the *Fov1* and QTL in the TM1 x 3-79 RIL on cotton chromosome 16.

Speed up the Breeding Process

- Marker Assisted Introgression (MAI).
- Marker Assisted Selection (MAS).
  - Marker & R Gene Discovery
  - Closely Tracking the Gene of Interest
  - Helpful when Inheritance is not simple.

Collaborators

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Cotton Incorporated