

# Breeding for Bacterial Blight Resistance in Cotton

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## Outline

1. Review breeding work for bacterial blight resistance.
2. TAM-MAR methods and modifications.
3. Importance of bacterial blight resistance.
4. Concerns: Host differentials and race identification, access to cultures of virulent races.



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# Breeding for Bacterial Blight Resistance in Cotton

## I. Review of breeding work

- Knight and Clouston. 1939. Inheritance, major “B” series of genes with modifier genes.
- Bird and Blank. 1951. Methods for screening.
- Brinkerhoff and Bird. 1950’s through early 1980’s.
- Brinkerhoff. 1963. Technical Bulletin T-98 (95 pages)
- Hunter, Brinkerhoff, and Bird. 1968. Identification of races.
- Bird. 1982. The MAR system.
- Brinkerhoff, Verhalen, et al. 1984. Immunity to bacterial blight and implications to other diseases.



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# Breeding for Bacterial Blight Resistance in Cotton

## I. Review of breeding work

Cotton breeding programs that actively screen for resistance to bacterial blight (my list):

- Bird, El-Zik, Thaxton: TAM-MAR.
- Several Texas seed companies.
- Stoneville Pedigreed Seed Co. - 1970's, 1980's.
- Thaxton: Mississippi State – 2000's

Current:

- Bourland at Miss. State & UA. - 1978 to present.
- Texas seed companies?
- CSIRO (FiberMax germplasm), Australia.
- Fundação MT – Mato Grosso, Brazil.



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# Breeding for Bacterial Blight Resistance in Cotton

## I. Review of breeding work

Why has BB resistance been a low breeding priority in U.S.?

- Low incidence of BB (acid-delinting).
- Low yield loss associated with BB (timing and degree of leaf loss from canopy; boll rots).
- Low interaction of BB with center pivot irrigation.
- BB resistance not considered worth the extra work required to inoculate and screen materials.

# Breeding for Bacterial Blight Resistance in Cotton

## II. TAM-MAR methods and modifications



**Fig. 3.** Seed with no mold growth and only slightly emerging radicles (top right) after 8 days at 13.3 C are selected. Not selected are seed with radicles extending into the crook (top left) or with mold growth or damaged radicles (middle and bottom).



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## II. TAM-MAR methods and modifications



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## II. TAM-MAR methods and modifications

Current UA screening for bacterial blight resistance:

1. Evaluate all segregating populations ( $F_2$  through  $F_4$ ), progeny rows ( $F_5$  and  $F_6$ ), and seed increases (strains) that include at least one resistant parent.
2. After stand established, thin to individual plants (roguing).
3. Inoculate 2-4 leaf plants using Mud-Master® sprayer with mixture of races (include race 18). Surfactant (e.g. Silkin™) enhances inoculation success.

Evaluation:

- Select resistant plants from segregating populations.
- Discard progeny rows that have any susceptible progeny.
- Remove susceptible plants from seed increases.



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# Logistics – UA Cotton Breeding Program

| Year | Procedure                                   |
|------|---------------------------------------------|
| 1    | Cross made & winter increase                |
| 2    | Segregating pop. – Modified SSD             |
| 3    | Segregating pop. – Modified SSD             |
| 4    | Segregating pop. – Plant selection          |
| 5    | 1 <sup>st</sup> year progeny row evaluation |
| 6    | Advanced progeny row evaluation             |
| 7-10 | Replicated Strain Tests                     |
| 9+   | Regional Strain & State Variety Tests       |
| 10+  | Release germplasm line/variety or discard.  |



# UA Cotton Breeding Program Releases

## 82 Germplasm Lines and 4 cultivars since 1986

(Includes 15 germplasm lines released via Mississippi Agricultural and Forestry Experiment Station)

### Characteristics

- **76/86 are resistant to bacterial blight.**
- Most are resistant to **Fusarium wilt** (Nat'l Fus Wilt Test, Tallahassee, AL)
- Most have some resistance to **Verticillium wilt**.
- RKN, seedling disease, seed deterioration, heat stress?
- All conventional.
- 81/82 have normal leaf shape.
- 4 /82 are nectariless.
- 5 /82 possess exceptional fiber quality.
- Most are early maturing.
- Varying leaf, stem, and bract pubescence.
- Varying response to tarnished plant bug & other insects.
- Varying yield components & specific adaptation.

# Breeding for Bacterial Blight Resistance in Cotton

## III. Importance of bacterial blight resistance

Why do I breed for bacterial blight resistance?

- Easily established (if have access to good cultures).
- Establishes a distinctive characteristic.
- Provides insurance against epiphytotic.
- Aids in maintaining pure lines by identifying segregating progenies and off-types in seed increases.
- May enhance host plant resistance by adding to level of horizontal resistance (via resistance to all races).
- 43-year old habit!



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# Breeding for Bacterial Blight Resistance in Cotton

## IV. Concerns

### 1. Host differentials and race identification

Pathogenic reactions of seventeen races of *Xanthomonas malvacearum* on eight cotton differentials.<sup>a</sup>

| Race number | Acala<br>44 <sup>b</sup><br>none | Stoneville<br>2B-S9<br>polygenes | Stoneville<br>20<br>B7+poly | Mebane<br>B-1<br>B2+poly | 1-10B<br>B <sub>1n</sub> +poly | 20-3<br>B <sub>N</sub> +poly | 101-102B<br>B2B3+Unk. | Gregg <sup>c</sup><br>Unknown |
|-------------|----------------------------------|----------------------------------|-----------------------------|--------------------------|--------------------------------|------------------------------|-----------------------|-------------------------------|
| 1           | +                                | +                                | -                           | -                        | -                              | -                            | -                     | -                             |
| 2           | +                                | +                                | +                           | -                        | -                              | -                            | -                     | -                             |
| 3           | +                                | +                                | -                           | -                        | +                              | -                            | -                     |                               |
| 4           | +                                | +                                | -                           | -                        | -                              | +                            | -                     |                               |
| 5           | +                                | +                                | -                           | -                        | +                              | +                            | -                     |                               |
| 6           | +                                | +                                | -                           | +                        | +                              | -                            | -                     |                               |
| 7           | +                                | +                                | -                           | +                        | +                              | +                            | -                     |                               |
| 8           | +                                | +                                | +                           | +                        | +                              | -                            | -                     |                               |
| 9           | +                                | -                                | +                           | -                        | -                              | +                            | -                     |                               |
| 10          | +                                | +                                | +                           | +                        | +                              | +                            | -                     |                               |
| 11          | +                                | +                                | -                           | -                        | -                              | -                            | -                     | +                             |
| 12          | +                                | +                                | +                           | -                        | -                              | -                            | -                     | +                             |
| 13          | +                                | -                                | -                           | -                        | -                              | -                            | -                     |                               |
| 14          | +                                | +                                | +                           | -                        | +                              | +                            | -                     |                               |
| 15          | +                                | +                                | +                           | -                        | +                              | -                            | -                     |                               |
| 16          | +                                | +                                | +                           | +                        | -                              | +                            | -                     |                               |
| 17          | +                                | +                                | +                           | -                        | -                              | +                            | -                     |                               |

<sup>a</sup>+ = Susceptibility of differential, - = resistance.

<sup>b</sup>Bacterial blight resistance gene compliment of each differential.

<sup>c</sup>Gregg is included as a supplemental differential to distinguish between races 1 and 11, and 2 and 12.

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## IV. Concerns

### 1. Host differentials and race identification

- Availability and purity of all the host differentials?
- Purity and virulence of races (race 18)?
- Over time, are new races evolving?
- What races would likely occur in naturally infected fields?

### 2. Access to cultures of virulent races.

- Cultures of races (periodically confirmed using host differentials) were supplied by Bird, El-Zik, Thaxton.
- PDA plates supplies by Craig Rothrock.
- Restrictions to moving cultures across state lines (APHIS).
- Have tried to use Fundação MT methods which are based on field collected, infected leaves; but what is race identification?

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## IV. Concerns

### 2. Access to cultures of virulent races. - Fundação MT methods:

#### Preparing the inoculum and the bacterial suspension

- Collect cotton leaves infected with bacterial blight and dry them in an oven set with a temperature of 40°C;
- Grind leaves to a very fine powder. This procedure can be done with different approaches, i.e. mortar and pestle, electrical grinder, industrial blender;
- Infected material (dry leaves or powder) must be kept in a condition of 4 to 10°C, in order to avoid loss of bacterial activity;
- The correct rate for the spraying bacterial suspension is 4 grams of infected leaves (powder) per liter of water; (3.67 lb powder/110 gal tank)
- After the mixture, it is recommended to “rest” the bacterial suspension for 30 minutes in order for the inoculum to homogenize in the solution;
- Filter the bacterial solution using a fine sieve mesh in order to avoid obstruction of the spray nozzles;
- In every liter of the bacterial suspension prepared, it is recommended to add 2,5 mL a Silicone based adjuvant (i.e. Break-thru, Silwet L-77).

# Breeding for Bacterial Blight Resistance in Cotton

## IV. Concerns

1. Host differentials and race identification
2. Access to cultures of virulent races.
3. Be able to effectively, efficiently, and confidently screen for resistance.



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