Breeding for Bacterial Blight Resistance in Cotton

Fred Bourland

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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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.

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II. TAM-MAR methods and modifications

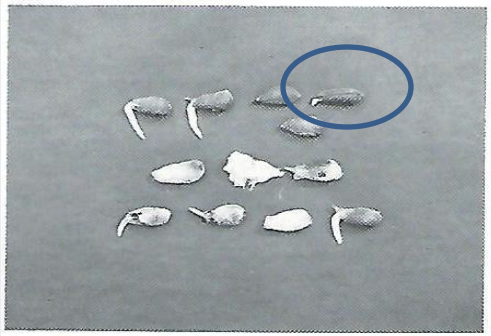

Fig. 3. Seed with no mold growth and only slightly emerging radicles (top right) after 8 days at 13.3 C are selected. Not selected are seed with radicles extending into the crook (top left) or with mold growth or damaged radicles (middle and bottom).

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II. TAM-MAR methods and modifications

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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	1st 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.

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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, Tallassee, 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.**

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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.[a]

Race number	Acala 44 none[b]	Stoneville 2B-S9 polygenes	Stoneville 20 B_7+poly	Mebane B-1 B_2+poly	1-10B B_{In}+poly	20-3 B_N+poly	101-102B B_2B_3+Unk.	Gregg[c] Unknown
1	+	+	-	-	-	-	-	-
2	+	+	+	-	-	-	-	-
3	+	+	-	-	+	-	-	
4	+	+	-	-	-	+	-	
5	+	+	-	-	+	+	-	
6	+	+	-	+	+	-	-	
7	+	+	-	+	+	+	-	
8	+	+	+	+	+	-	-	
9	+	-	+	-	-	+	-	
10	+	+	+	+	+	+	-	
11	+	+	-	-	-	-	-	+
12	+	+	+	-	-	-	-	+
13	+	-	-	-	-	-	-	
14	+	+	+	-	+	+	-	
15	+	+	+	-	+	-	-	
16	+	+	+	+	-	+	-	
17	+	+	+	-	-	+	-	

[a] + = Susceptibility of differential, - = resistance.

[b] Bacterial blight resistance gene compliment of each differential.

[c] 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 recommend 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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