2003 BELTWIDE COTTON CONFERENCES, NASHVILLE, TN – JANUARY 6-10

EFFECTS OF BACTERIAL BLIGHT RESISTANCE GENES AND *AGROBACTERIUM TUMEFACIENS* VIRULENCE ON DEVELOPMENT OF BRONZE WILT SYMPTOMS AND COTTON YIELD LOSSES

Alois A. Bell
USDA-ARS
College Station, TX

Abstract

This study was designed to determine the relative contributions of *Agrobacterium* concentrations and major bacterial blight resistance genes (*B* genes) to yield losses and bronze wilt symptoms. Eight different isolates of *A. tumefaciens* (1A, 7A, 14C, 16B, 25A, 26A, 34B, and RIB) that varied in virulence were used to give a range of bacterial concentrations in roots. Each isolate was used to inoculate each of seven isolines of Acala 44 : E (no *B* gene), B_2, B_4, B_{5a}, B_6, B_7, B_{In}; and nine bacterial blight race differentials: Stoneville 2B-S9 (no *B* gene), Deltapine PxP4-S (no *B* gene), Mebane B-1 (B_2), 101-102B (B_2, B_3), Empire B4 (B_4), Stoneville 20 (B_7), S-295 (B_{12}), 1-10B (B_{In}), and 20-3 (B_n). There were 15 replications of each combination with five sacrificed at initial flower to determine *Agrobacterium* concentrations and 10 kept to boll opening. The isolines alone were tested in the fall of 2001 and the isolines and differentials were tested in the spring of 2002 in the greenhouse. Cooling fans were set at 30°C and heaters were set at 20°C prior to flower and 25°C after flower.

The highest *Agrobacterium* concentrations in roots were correlated with leaf blighting prior to first flower and yield decline, but were not correlated with bronze wilt severity. In the fall, plants inoculated with *A. tumefaciens* isolates 7A and 14C had the highest bacterial concentrations and yielded 8-10% less than those inoculated with the RIB isolate which gave the lowest bacterial concentrations. In the spring, plants inoculated with isolates 25A and 1A had significant yield reductions of 14 and 18% compared to the yields or plants inoculated with the 16B isolate which had the lowest bacterial concentrations. The six more aggressive *A. tumefaciens* isolates developed higher concentrations in the spring than they did in the fall.

The presence of bacterial blight resistance genes was strongly associated with severe bronze wilt symptoms, especially in the race differentials, but these genes were not consistently associated with yield changes or *A. tumefaciens* concentrations. Both significant increases and decreases in yields were associated with B_2 and B_{5a} in different comparisons, while B_4 was associated with significant yield increases in 2 of 3 comparisons.

To better understand the effects of *B* genes on yields and bacterial concentrations, the Acala 44 isolines were compared in controlled environment chambers at different night temperatures (20 or 25°C; both 30°C days) and at different phosphorus fertilization rates (7.5 or 24 mg P_2O_5/week). At the 24 mg P_2O_5 rate, all *B* genes were associated with decreased bacterial concentrations and increased yields at 20°C, but this relationship broke down and yield decreases were associated with *B* genes at 25°C. Thus, *B* genes apparently provide effective resistance to *Agrobacterium* infections at low, but not high, night temperatures. At 25°C, the resistance responses appear to become systemic and severe, resulting in plant damage regardless of decreased bacterial concentrations.

To further clarify possible relationships between *B* genes and bronze wilt symptoms, the bacterial blight differentials were compared in controlled environment chambers at 12 versus 14 hour photoperiods with 25 °C nights and 7.5 mg P_2O_2 per week. Decreasing the photoperiod from 14 to 12 hours delayed the onset of bronze wilt symptoms and resulted in increased yields in all cotton lines and varieties. The 12-hr photoperiod, however, more clearly revealed relationships between bronze wilt symptoms and *B* genes. With this photoperiod, at least 40% of the plants with any *B* gene eventually developed severe bronze wilt (collapse and death of the terminal leaves and stems), whereas plants of Stoneville 2B-S9 (no *B* genes) developed only mild symptoms.

The results of these experiments show that major *B* genes predispose cotton plants to the development of bronze wilt symptoms especially under conditions of high temperature and light stress. The symptoms may be the consequence of systemic hypersensitive reactions in the plants which are triggered by microorganisms, such as *Agrobacterium tumefaciens*. This hypothesis is currently being tested.