# DIAGNOSIS OF *FUSARIUM OXYSPORUM F. SP. VASINFECTUM* RACE 4 SYMPTOMS IN PIMA AND UPLAND COTTON CULTIVARS

**Mauricio Ulloa**
**USDA-ARS, PA, CSRL, Plant Stress and Germplasm Development**
**Lubbock, TX**
**Robert B. Hutmacher**
**University of California, West Side Research and Extension Center**
**Five Points, CA**
**Margaret L. Ellis**
**California State University, Fresno, Department of Plant Science**
**Fresno, CA**
**Robert L. Nichols**
**Cotton Incorporated**
**Cary, NC**

## Abstract

Fusarium wilt of cotton (*Gossypium* spp.) is caused by the soil-borne fungal pathogen, *Fusarium oxysporum* f. sp. *vasinfectum* (*Fov*). Various races of the disease have been long-term problems for cotton production in many regions, contaminating soils and causing cotton yield losses. Isolates of *Fov* race 4 (FOV4) that were not previously known in North America and that are extraordinarily pathogenic on cotton have been found in the U.S. in the past decade. This fungal pathogen is particularly difficult to control, since it resides in woody vascular tissues of cotton stalks and roots, and its overwintering structures can survive in soils for many years. In the San Joaquin Valley of California, FOV4 has been a threat to cotton production since 2004. A high level of tolerance to FOV4 was identified in a commercial Pima cotton (*G. barbadense* L.), Phytogen 800®. The source of the tolerance is believed to have originated in Pima S-6 germplasm. Moderate levels of tolerance, but not resistance has been identified in commercial cultivars of Upland cotton (*Gossypium hirsutum* L.). Recently FOV4 has been identified in the El Paso, TX area. This serious soil and seedborne cotton fungal disease threatens Upland cotton production with potentially significant yield losses if the pathogen spreads to other parts of Texas and the Cotton Belt.

Symptoms of the pathogen have been observed to differ between Pima and Upland cotton. Early season (1$^{st}$ through 8$^{th}$ leaf) mortality is an important phenotypic trait for identifying tolerance/resistance in both Upland and Pima germplasm. FOV4 can affect cotton at any time in the season, but is often seen as early season stunting, wilting, and leaf necrosis at or before the 4-6 leaf stage. Such injury at seedling stage can resemble to some degree disease symptoms caused by other fungal pathogens, such as *Rhizoctonia solani*. Onset timing and levels of damage differ according to levels of tolerance in the respective Gossypium species. Certain susceptible Pima cotton cultivars are more sensitive to FOV4 infection than are the majority of Upland cottons. In highly-susceptible Pima cultivars, recognition of foliar necrosis, yellowing and wilt symptoms are relatively simple to recognize. In contrast, our observations have been that many Upland lines can be infected as evidenced by root vascular staining but will not have simple to recognize foliar symptoms, evident of FOV-4 infection. The most diagnostic symptom of FOV4 in Upland cotton is basal vascular staining. Staining can be limited to the hypocotyl, upper tap root, and lateral roots. It is not generally evident in above-ground stem tissue. Host-plant resistance and planting tolerant/resistant cultivars is an effective strategy to manage FOV4 damage and losses in cotton. Progress has been made by the private and public sectors in identifying and developing tolerant/resistant Pimas. In Upland cotton, germplasm with good levels of tolerance have been identified, and new breeding lines are being developed by USDA-ARS and the University of California with the support of Cotton Incorporated, CA Cotton Alliance and the CA Cotton Growers and Ginners Association. With the recent identification of FOV4 in Texas, this pathogen has potential to threaten the largest Upland cotton producing state in the U.S. It is important to increase the tolerance/resistance levels of the Upland gene pool to reduce this vulnerability in the cotton industry.