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Fusarium Wilt of Cotton

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INTRODUCTION: Fusarium wilt is a destructive vascular wilt and root rot of many plant species, including all species of domesticated cotton. The disease was first described in Alabama cotton fields in 1892 and is now widespread in most states across the US Cotton Belt and throughout the world. Fusarium wilt often kills susceptible plants in a heavily infested field. It may cause significant yield losses to growers. In the past, Fusarium wilt of cotton often tended to occur only in susceptible cultivars grown in neutral to acidic sandy soil with significant populations of root knot nematode. However, a new variant of the Fusarium wilt fungus (race 4 or FOV4) was found widespread in the San Joaquin Valley of California in 2001. Since 2017, race 4 has been found in many fields in New Mexico and western Texas. Fusarium wilt can be a major problem with associated yield losses exceeding 29,100 bales across the US Cotton Belt. However, disease incidence and yield losses can be highly variable from region to region as well as from country to country, depending on susceptibility of cotton cultivars, aggressiveness or virulence of fungal strains or races, pathogen inoculum levels built-up in the soil, soil type and pH, and nematode populations. In Arizona, Fusarium wilt occurs sporadically and typically is not a major problem in most years. FOV4 is considered to be the most important threat to sustainable cotton production in the US. To date, FOV4 has not been found in Arizona cotton fields. This publication is designed to heighten awareness of Fusarium in general so that growers can be alert to any unusual incidences or severity of symptoms that might indicate establishment of FOV4 in Arizona cotton.

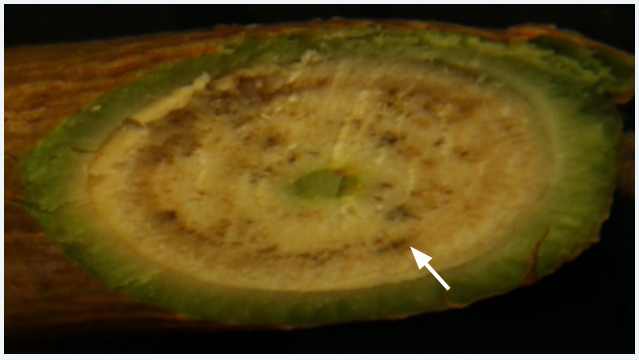
PATHOGEN: *Fusarium oxysporum* f. sp. *vasinfectum* (abbreviated as FOV, *ascomycetes*) is a soil-inhabiting fungus that can also infect seeds, but seed transmission is low. This fungus has several distinct strains or races that cause similar symptoms on a wide range of susceptible cultivars. Prior to 2001, FOV race 1 or race 2 were responsible for the Fusarium wilt of cotton grown in neutral to acidic soil in the US. They require the presence of root-knot nematode populations to

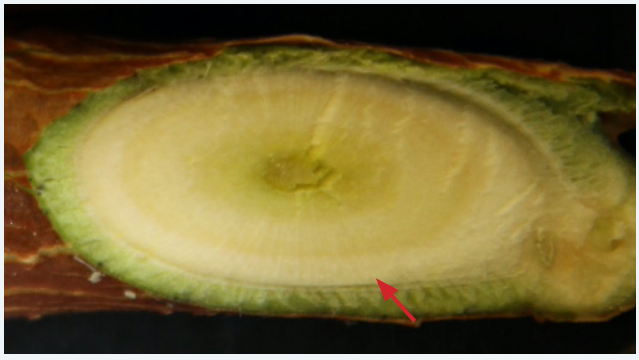
SYMPTOMS

Cotton fields infested with Fusarium Wilt

Yellowing, wilting, and dying of FOV-infected plants

Brown staining of vascular tissues of plants infected with Fusarium wilt



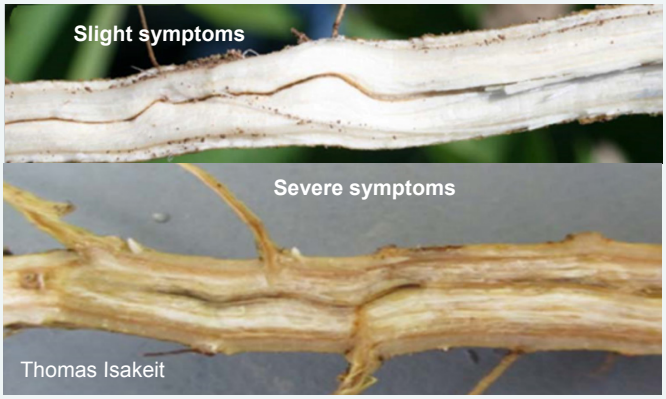


Vascular tissues of healthy plant (white arrow) vs Light to dark brown streak (flecking) of plant infected with Verticillium wilt (red arrow)

FOV4 SYMPTOMS

Seedlings killed by FOV4


Interveinal and marginal leaf chlorosis and necrosis



Pencil-line pith staining of taproots

Continuous staining in taproot of late season upland cotton

cause visible symptoms and economic damage. In contrast, the newly emerged FOV4 is more aggressive and virulent on many susceptible Pima cultivars and Upland cultivars grown in neutral to alkaline soil in the absence of root-knot nematode.

HOST RANGE: FOV is specific to cotton and primarily causes disease in susceptible cultivars of all domesticated cotton species: *Gossypium arboretum*, *G. barbadense*, *G. herbaceum*, and *G. hirsutum*. All races of FOV cause disease only in susceptible cotton cultivars, even if they can colonize many other plant species without causing visible symptoms. The alternative weed hosts include bladder ketmia, sesbania pea, dwarf amaranth, bellvine, and wild melon. Other plant species that can harbor FOV include tobacco, coffee, capsicum, okra, pigeon pea, pea, cowpea, sesame, and Hevea rubber.

SYMPTOMS AND DIAGNOSIS: FOV attacks roots and damages cotton plants at all growth stages. However, FOV4 tends to occur at seedling stage or in young plants with 2-10 nodes. The external plant symptoms include yellowing and wilting on the margin of the leaf, stunting, defoliation or plant death. The typical internal symptom is vascular discoloration manifested as continuous, dark brown staining in the stem or the tap roots (FOV4). Field signs begin with barren spots (areas devoid of plants or with dead plants) or areas with yellowing or wilting plants.

CONDITIONS CAN BE CONFUSED WITH: Seedling diseases, Verticillium wilt. Vascular staining of Fusarium wilt is continuous browning, while that of Verticillium wilt is flecking. All races of FOV cause similar symptoms, so confirmation of FOV4 can only be made by a plant pathology laboratory. Symptomatic plants should be collected and wrapped in a dry paper towel, placed in a plastic bag, and shipped **OVERNIGHT** to the University of Arizona's Extension Plant Pathology laboratory in Tucson. All submissions should be accompanied by a completed Plant Disease Diagnostic Form. If you have any questions regarding this and other cotton diseases, contact your local extension office or Randy Norton (e-mail:rnorton@arizona.edu; phone: 928-651-0420) or Alex Hu (e-mail:epp@arizona.edu; phone:863-594-0505).

DISEASE CYCLE: FOV survives as a saprophyte on the organic matter in the soil and can colonize roots of weeds and other plant species. It produces numerous thick-walled spores, chlamydospores, which are capable of persisting indefinitely in soil. FOV spores germinate to form hyphae in the proximity to host plant roots. Initial infection occurs as the hyphae enters the root through wounds such as feeding injuries by nematodes or direct penetration. The fungus colonizes the vascular tissue and stem and produces microconidia that are distributed throughout the plant. It damages the water-conducting vascular tissue of the plant (the xylem), disrupting water and nutrient uptake from soil, and thus causing wilting and possible plant death that depends on variety susceptibility and infection timing. FOV produces both short-lived conidia and long-lived chlamydospores on infected plants which are returned to the soil or spread by contaminated soil, seeds, crop residues, irrigation water, and equipment.

MANAGEMENT: Disease management is often difficult as the pathogen persists in the field for decades and a variety may provide resistance or tolerance only to specific race(s) of FOV. Once the fungus is introduced into a field, it is virtually impossible to eradicate the fungus from a contaminated field. There are no cost-effective fungicides available for elimination of FOV from the soil. Cultural practices such as crop rotation, fallowing, tillage, and solarization may reduce FOV populations. When a susceptible cultivar is planted in an infested field, FOV populations in the soil buildup to much higher levels that risk breaking resistance of cultivars subsequently planted. Inspect, track and map infestations so that you can isolate Fusarium fields and plant resistant cultivars there, when available. A combination of approaches must be used for disease mitigation: 1) plant resistant or tolerant varieties, including root-knot resistant varieties for Fusarium wilt associated with nematodes. Resistant variety may slowdown the buildup of FOV populations, but may not reduce the FOV populations; 2) plant pathogen free seeds; 3) rotate to non-host crops for inoculum reduction in soil; 4) use nematicides to control nematode populations when indicated; 5) control weeds; and 6) limit further spread by avoiding irrigation water run-off from infested fields, preventing infested plant materials and soils from moving across a field by equipment and personnel traffic, harvesting non-infested field before an infested field, cleaning the equipment coming from an infested field, and burying or baling crop residues after harvest.

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