EVALUATION OF COMMERCIAL UPLAND COTTON VARIETIES FOR REACTION TO *FUSARIUM OXYSPORUM* F. SP. *VASINFECTUM* RACE 4 IN TEXAS

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Abstract

Fusarium wilt of cotton race 4 (FOV4), caused by the fungus *Fusarium oxysporum* f.sp. *vasinfectum*, is now widespread in two, far-west counties of Texas and is a potential threat to production in other areas of the state, should it ever become widespread. In 2020, 71 commercial Upland varieties and one experimental line were evaluated for their susceptibility to FOV4 in an infested soil on a farm in El Paso county, in Texas. The experiment was planted using four replicates arranged in a randomized complete block design. Susceptibility determination was based on the incidence of post-emergence damping-off, which was verified to be exclusively associated with FOV4. All varieties were susceptible to FOV4, with the means of post-emergence damping-off among the varieties ranging from 4% to 36% This study suggests that less-susceptible Upland varieties could be deployed to manage the disease, but the long-term effectiveness of this strategy is not known.

Introduction

Fusarium wilt of cotton race 4 (FOV4), caused by *Fusarium oxysporum* f.sp. *vasinfectum* race 4, is now widespread in many fields throughout El Paso and Hudspeth counties, in Far West Texas. Symptoms of this disease were first observed in that area in 2016 (Halpern *et al*., 2018). In the United States, this race was previously detected in California in 2001 and became widespread in the San Joaquin Valley since then. FOV4, unlike other races found in the United States, does not require the presence of root knot nematodes to cause damage (Cianchetta and Davis, 2015). The pathogen can be introduced into non-infested soils via seed (Bennett *et al*., 2008). Thus, the introduction of FOV4 into other growing areas of Texas is of great concern. As host resistance is the best approach for managing FOV4, the objective of this research was to evaluate the susceptibility of commercial Upland cotton varieties planted into a FOV4-infested field.

Materials and Methods

The experiment was planted May 4, 2020 in a FOV4-infested field near Fabens, TX. There were four replicates of 71 commercial Upland varieties and one Upland line planted in a randomized complete block design. The experiment was placed in a severely-infested area of the field, based on prior observations. Each replicate consisted of 100 seed planted in 16-foot-long single-row plots on a raised bed. The soil type is a Glendale silty clay (pH 8.2, 38% sand, 23% silt, 39% clay, 1.38% soil organic matter). Stand counts to evaluate post-emergence damping-off (Figure 1) were made on June 1 and the plant stand was evaluated on September 8. No root necrosis ratings were made, nor was yield evaluated.

Figure 1. Post-emergence damping-off in the plots, 28 days after planting.

Table 1. Post-emergence damping-off (mean and highest replicate values) and plant stand of 71 Upland cotton varieties and one Upland line grown in a field infested with FOV4, with the least and the most susceptible varieties highlighted in green and red, respectively.

Variety	Post-emergence damping-off (%)[1]	Damping-off, highest value of the four replicates (%)	Plant stand (%)[2]
BX2005GLT	17.3	27.0	27.3
BX2037GLT	7.4	10.8	27.3
BX2076GLTP	13.6	28.9	34.5
DG3615 B3XF	21.8	39.7	38.0
DGX19001B3XF	16.7	29.7	24.5
DGX19004B3XF	20.6	29.5	24.0
DGX19007DB3XF	14.7	23.8	29.0
DGX19010B3XF	12.5	22.0	26.5
DGX19011B3XF	10.6	15.9	34.0
DGX19015B3XF	8.1	13.5	24.8
DGX19019B3XF	17.4	35.3	41.0
DGX19021B3XF	21.6	35.4	34.0
DGX19025B3XF	13.6	33.3	36.5
DP1522B2XF	17.2	24.1	38.3
DP1612B2XF	26.6	28.3	31.3
DP1646B2XF	12.5	17.9	27.8
DP1747NRB2XF	11.1	17.5	31.5
DP1820B3XF	7.9	21.7	32.0
DP1822XF	20.0	30.8	30.5
DP1823NRB2XF	7.1	14.3	25.0
DP1835B3XF	6.2	13.5	31.3
DP1840B3XF	12.7	20.4	26.5
DP1845B3XF	9.1	12.1	28.5
DP1851B3XF	21.5	22.8	27.3
DP1908B3XF	6.9	16.7	23.8
DP1909XF	14.3	23.4	28.5
DP1916B3XF	16.9	31.3	30.0
DP1948B3XF	8.9	15.4	20.3
EXP1 B3XF (line)	5.4	21.4	19.0
FM1320GL	15.6	35.3	33.8
FM1621GL	15.5	19.0	36.3
FM1830GLT	10.6	15.6	35.3
FM1911GLT	9.3	12.9	48.5
FM2322GL	10.7	21.2	22.8
FM2334GLT	17.4	25.6	35.8
FM2398GLTP	9.9	13.0	31.8
FM2498GLT	21.6	34.0	36.0
FM2574GLT	12.2	26.1	38.3
FM4550 GLTP	11.2	17.4	36.5

MX19A005B3XF	11.9	37.0	36.3
NG2982B3XF	20.0	29.3	38.0
NG3500XF	9.2	20.4	43.3
NG3640XF	3.8	8.5	32.5
NG3780B2XF	20.7	42.9	33.3
NG3930B3XF	14.4	26.3	42.3
NG3956B3XF	15.6	22.8	38.3
NG3994B3XF	10.9	17.2	24.3
NG4545B2XF	24.2	35.3	33.5
NG4689B2XF	14.8	25.5	40.8
NG4777B2XF	17.9	22.9	32.5
NG4792XF	10.9	20.0	33.8
NG4936B3XF	14.8	21.6	28.5
PHY 350W3FE	17.0	24.5	38.5
PHY210W3FE	21.0	25.4	45.0
PHY320W3FE	13.9	23.5	42.0
PHY333WRF	16.5	28.2	25.3
PHY400W3FE	19.6	27.6	26.8
PHY480W3FE	23.1	38.6	32.3
PHY490W3FE	14.7	32.7	33.0
PHY580W3FE	21.3	38.6	33.0
PX2B14W3FE	19.9	36.8	43.3
PX2C14W3FE	13.3	25.6	46.3
PX3D32W3FE	19.3	30.2	37.5
PX3D43W3FE	13.1	23.0	44.8
PX5C05W3FE	24.4	57.8	31.0
PX5C45W3FE	36.0	52.0	29.0
PX5E28W3FE	13.4	22.6	38.5
PX5E34W3FE	11.9	25.9	38.0
ST4946GLB2	9.6	16.1	43.3
ST4990B3XF	7.3	10.3	30.3
ST5600B2XF	10.0	21.7	25.0
ST5707B2XF	13.9	24.6	42.8
LSD (P=0.05)	*11.1*	*not applicable*	*9.7*

[1]Mean of four replicates, evaluated 28 days after planting.
[2]Mean of four replicates, evaluated four months after planting.

Results and Discussion

The incidence of post-emergence damping-off 28 days after planting and stand counts four months after planting are shown in Table 1. Varieties with the highest and lowest incidence of post-emergence damping-off are indicated with red and green highlighting, respectively. Isolations from symptomatic seedlings yielded only FOV4. Differences among varieties in both post-emergence damping-off and stand were highly significant (P<0.01). However, there was also a highly significant ($P<0.01$) blocking effect, indicating an inoculum gradient within the field. The disease incidence was greater at the tail end of the field. The mean incidence of post-emergence damping-off among varieties ranged from 4% to 36%, while that of plant stand ranged from 19% to 48%. Four months after planting, there were no wilting symptoms in any of the Upland varieties, while some plants of a FOV4-susceptible Pima variety were wilting, along with substantial stand loss (Fig.2). Root necrosis was observed in a few of the non-wilted plants that were examined at that time (Fig.2).

Figure 2. Left photos: Portion of the field, planted to a FOV4-susceptible Pima variety, showing extensive stand loss. Internal root necrosis is common in surviving plants. Right photos: Plants in the commercial Upland variety trial, in the same field. Internal root necrosis is also present in plants. September 2020.

All varieties tested in this experiment were susceptible to FOV4, but there was a large difference in the degree of susceptibility. The inoculum density of FOV4 in this field was devastating to the FOV4-susceptible Pima variety later in the season, as seen by extensive stand loss, but damage was not noticeable with the Upland varieties (Fig. 2). However, while the Upland varieties showed no wilting in September, many of those plants, including varieties that had relatively low incidences of post-emergence damping-off, showed internal root necrosis symptoms of FOV4. The effect of this degree of susceptibility on yield was not measured in this experiment, but there may be a potential for yield loss, particularly at the higher inoculum densities that could result from continued planting of susceptible varieties.

Summary

All of the commercial Upland varieties were susceptible to FOV4 to some degree.

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