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. Thirty-seven commercial Upland varieties were evaluated for their susceptibility to FOV4 in an infested soil in El Paso County in 2019. The experiment was planted using 5-6 replicates arranged in a randomized block design and included a FOV4-susceptible Pima variety for comparison. Susceptibility was based on the incidence of post-emergence damping-off and the severity of root necrosis, using a 0-5 rating scale. All varieties were susceptible to FOV4 based on these two symptoms. The range of post-emergence damping-off among the varieties was 0-49%, while the range of root necrosis ratings were 1-4. This study suggests that more resistant varieties could be deployed to manage the disease.

Introduction

Fusarium wilt of cotton race 4 (FOV4), caused by *Fusarium oxysporum* f.sp. *vasinfectum* race 4, was confirmed in Far-west Texas (El Paso and Hudspeth counties) in 2017 (Halpern *et al*., 2018). In the United States, this race was previously detected in California in 2001. FOV4, unlike other races found in the United States, does not require the presence of nematodes to cause losses (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 April 23, 2019 in an FOV4-infested field near Fabens, TX. There were 5-6 replicates of 37 commercial Upland varieties and one FOV4-susceptible Pima variety planted in a randomized block design. Each replicate consisted of 100 seed planted in 20-foot-long single-row plots on a raised bed. The soil type is a Glendale silty clay. Stand counts, evaluating post-emergence damping-off, were done May 30 (Fig. 1) and the roots of five plants per plots were sliced lengthwise and rated for necrosis (0-5 scale, where 0=no symptoms and 5=completely necrotic) on June 27 (Fig. 2). Yield was not measured.

Figure 1. Post-emergence damping-off caused by *Fusarium oxysporum* f. sp. *vasinfectum* Race 4.

Figure 2. Root necrosis symptoms caused by FOV4. **A.** Moderate, this rates 2-3. **B.** Severe, this rates 4-5.

Results and Discussion

Table 1. Damping-off (DO, %) and root necrosis (RN) ratings (0-5 scale) of 38 cotton varieties (37 Upland, 1 Pima), average of 5-6 replicates and values for the most-diseased replicate for the variety.

VARIETY	AVERAGE % DO	AVERAGE RN RATING	REPLICATE HIGHEST % DO	REPLICATE HIGHEST RN
3-79 Pima	37.6	1.6	91.8	4
AMX1815B3XF	11.5	1.0	18.8	3
AMX1823B3XF	6.7	0.9	25	3
BX1921GL (FM 1621 GL)	16.9	1.3	28.1	3
BX1972GLTP	13.8	1.5	31	4
CG 3475B2XF	13.0	1.2	45.2	4
CG 3527B2XF	8.5	0.7	21.7	4
CPS18504DB3XF	0.0	1.3	0	4
DP 1725B2XF	9.1	1.5	28.6	4
DP 1822XF	9.8	0.9	33.3	3
FM 1830GLT	6.0	1.1	9.7	3
FM 1911GLT	7.5	0.8	22.9	3
FM 1953	9.0	1.2	19.4	3
FM 2398	4.3	0.7	10.7	3
FM 2484B2F	6.6	0.7	22.5	3
FM 2498	16.7	2.1	30.9	4
NG 3500XF	7.2	0.5	11.8	3
NG 3517B2XF	11.1	1.4	21.4	4
NG 3640XF	1.5	0.4	3.8	1
NG 3699B2XF	6.8	1.2	20.5	4
NG 3994	3.3	1.1	13	4
NG 5711	3.5	0.8	10.7	4
PHY 300W3FE	6.9	0.3	13.8	2
PHY 320W3FE	4.5	0.6	7.4	3
PHY 330W3FE	8.5	0.5	17.4	3
PHY 340W3FE	5.8	0.3	9.1	2
PHY 350W3FE	4.2	0.3	6.8	2
PHY 499	4.7	0.7	10	4
PX2A31W3FE	10.6	0.9	29.3	3
PX3B307W3FE	26.8	1.6	47.2	4
PX3C06W3FE	17.8	1.3	36.1	3
ST 4848 GLT	16.9	1.9	39	4
ST 5122GLT	23.4	1.6	48.6	4
ST 5471	4.5	0.4	10.3	3
ST 5600	8.9	0.4	17.2	2
ST 5707	3.5	0.5	4.5	2
ST5122	17.4	0.8	17.4	4
WU18XC9	9.6	1.4	23.8	3

Disease evaluations are shown in Table 1. Plants in some of the replicates had no disease symptoms, indicating no or low FOV4 inoculum in portions of the field. Thus, for each variety, the replicate with the highest levels of disease is also presented in Table1. In FOV4-infested portions of the field, there were no visible foliar symptoms, such as wilt or leaf necrosis, in the Upland varieties. In contrast, a commercial, FO4-susceptible Pima variety in another part of the field showed such symptoms during the growing season, in addition to stand loss observed earlier in the season (Fig. 3).

This experiment illustrated large differences in FOV4 susceptibility of Upland varieties and supports the use resistant varieties for management, should the pathogen be introduced into other areas of Texas.

Isolations from symptomatic plants in this field made in 2018 and 2019 yielded only *F. oxysporum* and no other soilborne fungi. Bell *et al*. (2019) reported genetic diversity in isolates of FOV4 from Far-west Texas. To obtain information on the *F. oxysporum* isolates from this field, symptomatic plants from the commercial Pima portion of the field (Fig. 3) were collected in May, June and August and isolations for *F. oxysporum* were made from them. Isolates were single-spored and analyzed for FOV4 identity using the Agdia AmplifyRP Acceler8 test kit for FOV4 (Doan *et al*., 2014). Isolates were preserved on silica gel for future study.

There were 53 *F. oxysporum* isolates collected in May and 58% of them were negative for FOV4, using the kit. There were 35 isolates collected in June and 28% of them were negative for FOV4. There were 88 August isolates and 33% of these were negative for FOV4. In an initial growth chamber trial, two out of three FOV4-negative isolates caused root necrosis on three-week-old seedlings of ST 4848 GLT, while three out of three FOV4-positive isolates caused root necrosis. Further pathogenicity experiments are underway.

Figure 3. Stand loss of a susceptible Pima variety caused by FOV4, in another part of the field.

Conclusions

In spite of variability of inoculum density within the field, this study showed that Upland varieties differ in their susceptibility to FOV4, suggesting that more resistant varieties could be planted in infested fields to manage this disease. This type of field screening approach can be useful in identifying useful varieties.

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