COTTON CULTIVAR DISEASE INCIDENCE, SEVERITY, AND YIELDS WHEN CHALLENGED WITH VERTICILLIUM WILT IN THE TENNESSEE VALLEY REGION, 2017

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Introduction

Losses from Verticillium wilt for the U.S. between the years of 1990-2016 are approximately 480 million bales according to disease loss estimates (Lawrence et al., 2017). Verticillium wilt most often occurs in the Tennessee Valley region of Alabama and Tennessee causing a decline in plant health and yield. Two *Verticillium* species have been found in in the Tennessee Valley region, *V. albo-atrum* Reinke and Berthold (Palmateer et. al., 2004) and *V. dahliae* Kleb. (Land et. al., 2016). *Verticillium dahliae* is considered the primary causal agent of Verticillium wilt in cotton and first colonizes the root and then moves upward through the vascular system of the plant (El-Zik, 1985). Typically, symptoms include wilting, lack of lateral growth, and decreases in yield, fiber quality, and seed quality (Wheeler et. al., 2012; Xiao et. al., 2000). Defoliation is thought to lead to yield reductions resulting from the lack of photosynthetic activity. Disease incidence is higher on heavier soils with higher clay and silt content and may be linked to the lower temperatures and higher moisture levels. Moist soils from irrigation enhance the incidence of Verticillium wilt in cotton. Irrigation cools the soil thereby enhancing pathogen survival and increasing infection rates. As the timing intervals of watering regiments increase, so do the disease incidences of cotton plants (Schneider, 1948). There are no fungicides recommended for management of Verticillium wilt in cotton. The only effective management option producers have is to select a Verticillium wilt tolerant cotton cultivar (Raper, et al. 2107). The number of cotton cultivars available to producers, however, is limited. The life span of cotton cultivars is often less than 5 years thus a producer must constantly look for cultivars that yield well when challenged with Verticillium wilt. The overall goal of this study is to identify cotton cultivars for best management by evaluating cotton cultivars for disease resistance as measured by Verticillium wilt severity and tolerance as measured by yield.

Materials and Methods

Cotton cultivars were planted in commercial cotton fields naturally infested with *V. dahliae* to determine cultivar disease response to Verticillium wilt under field conditions. Two field locations were selected for the 2017 tests based on severity of Verticillium wilt and the willingness of growers to participate in this research. Seed of adapted cultivars and experimental lines expected to be released in the next season were provided by AGRI-AFC, LLC of Land O'Lakes (Decatur, AL). Cotton cultivars and lines were planted in a strip plot design with four replications with plots being 1 row with a 1.02 m row spacing by 150 to 200 m plots evenly spaced throughout the field locations. Verticillium wilt disease incidence and severity ratings were conducted near cotton plant maturity from 4 randomly selected 3 m sections of row in each plot. Verticillium wilt disease severity ratings were conducted near cotton plant maturity. Foliar symptoms of Verticillium wilt were evaluated on a scale from 1 to 5 with 1 = no foliar wilting, 2 = interveinal chlorosis and necrosis of the leaves, 3 = interveinal chlorosis and necrosis of the leaves with 10-30% of the plant defoliated, 4 = interveinal chlorosis and necrosis of the leaves with 40-60% of the plant defoliated, and 5 = 70-100% defoliation. Plants were individually rated and averaged for a total plot disease severity rating. Vascular discoloration was determined by cutting the plant stem longitudinally to expose the vascular cylinder, and the number of plants with a discolored vascular cylinder indicated the percent incidence. Stem sections with discoloration were collected for fungal isolation to confirm *Verticillium* spp. presence. Yields were collected at plant maturity from 75 feet of each cultivar within each strip trial using a two row plot cotton picker. Samples were ginned at the UT Cotton MicroGin to determine turnout. Data collected from the field trials were analyzed in SAS 9.4 (SAS Institute, Cary, NC) using the PROC GLIMMIX procedure. LS-means were compared between the cultivars using the Tukey- Kramer test at significant level of $P \leq 0.05$.

Results

Verticillium wilt disease incidence and severity ratings were variable between the cotton cultivars. Disease incidence ranged from 32 to 60 % of the plants of each cultivar with our resistant standard ST 4747 GLB2 with the lowest amount of vascular discoloration. The severity of the Verticillium wilt was also lowest for ST 4747 GLB2, CROPLAN 9608 B3XF and ST 5122 GLT although the disease severity of these cultivars was less than only DP 1845 B3FX and DP 1851 B3FX ($P > 0.01$). All the remaining cultivars had similar levels of Verticillium wilt incidence and severity (Fig. 1). Yields indicated significant differences between cultivars when challenged with Verticillium wilt (Table 1). Seed and lint cotton yields varied by 1429 and 574 lb/A, respectively. Ranking the cultivars by lint yield indicates ST 5471 GLTP, DP 1646 B2FX, CROPLAN 9608 B3XF, and DP 1614 B2FX produced numerically greatest yield under these disease conditions and these cultivar yields were 10 % greater than our resistant standard ST 4747 GLB2. Comparing the data between disease incidence and severity indicated a significant positive correlation ($R^2 = 0.5597$; $P < 0.0001$) between visual symptoms and the signs of the disease in the vascular system. A correlation between Verticillium wilt incidence and lint cotton yield was significant ($R^2 = -0.7377$; $P < 0.0001$) as well as the Verticillium wilt severity and lint cotton yield ($R^2 = -0.8109$; $P < 0.0001$) indicating that Verticillium wilt contributed to a reduction of 73 to 81 % of the cotton yield.

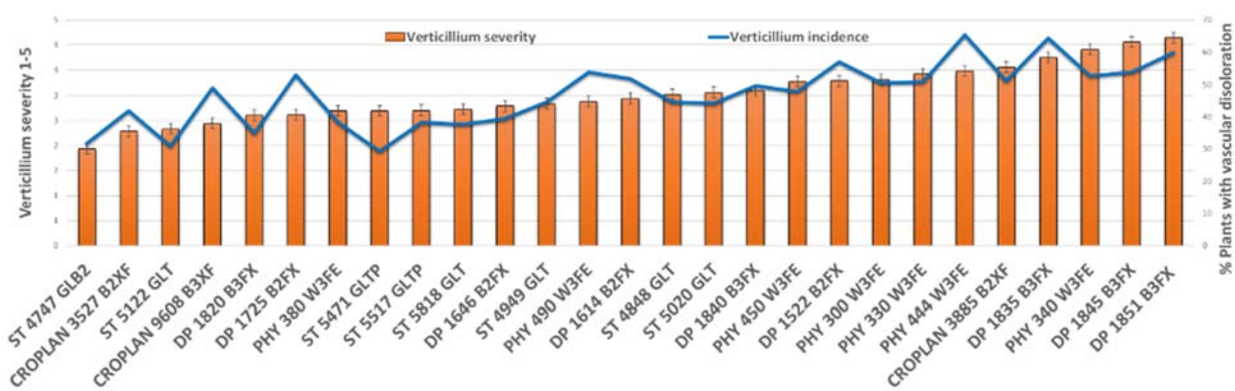

Figure 1. Verticillium wilt disease incidence and severity in the Tennessee Valley region, 2017.

Table 1. Cotton cultivar seed cotton, lint cotton and turnout percent in the Verticillium wilt fields, 2017.

Cultivar	Seed cotton lb/A		Lint cotton lb/A		Turnout %	
ST 5471 GLTP	2358	a	868	a	37	abcdefg
DP 1646 B2FX	2267	ab	855	a	38	abcde
CROPLAN 3527 B2XF	2080	abc	784	ab	38	abcdef
DP 1614 B2FX	2009	abc	761	ab	38	abcd
ST 4747 GLB2	1991	abc	739	abc	37	abcdefg
DP 1820 B3FX	1899	abc	729	abc	38	abc
ST 5122 GLT	2032	abc	729	abc	36	bcdefg
ST 4949 GLT	1876	abc	728	abcd	39	ab
ST 5818 GLT	2005	abc	713	abcd	36	cdefg
PHY 330 W3FE	1884	abc	697	abcd	37	abcdefg
PHY 380 W3FE	2038	abc	696	abcd	34	gf
ST 5020 GLT	1942	abc	688	abcd	35	defg
PHY 300 W3FE	1833	abc	686	abcd	37	abcdef
CROPLAN 9608 B3XF	1759	abc	686	abcd	39	a
ST 4848 GLT	1861	abc	682	abcd	37	abcdefg
ST 5517 GLTP	1874	abc	665	abcd	35	defg
DP 1522 B2FX	1890	abc	647	abcd	34	gf
DP 1725 B2FX	1674	abc	637	abcd	38	abc
PHY 490 W3FE	1746	abc	628	abcd	36	abcdefg
DP 1840 B3FX	1714	abc	599	abcd	35	defgh
CROPLAN 3885 B2XF	1660	abc	575	abcd	35	fgh
PHY 450 W3FE	1489	abc	517	abcd	35	efgh
PHY 340 W3FE	1252	abc	455	abcd	37	abcdefg
DP 1835 B3FX	1099	bc	412	bcd	38	abcdef
PHY 444 W3FE	1153	bc	405	Bcd	35	defgh
DP 1851 B3FX	938	c	323	Cd	34	gf
DP 1845 B3FX	909	c	294	Cd	32	h

Column LS-mean values with different letters are significantly different by Tukey Kramer's at P > 0.05.

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