RESPONSE OF TEN COTTON VARIETIES TO VERTICILLIUM WILT IN THE NORTHERN ROLLING PLAINS

J. E. Woodward
Texas A&M AgriLife Extension Service
Texas Tech University
Lubbock, TX
J. H. Ramirez
Texas A&M AgriLife Extension Service
Vernon, TX
G. D. Morgan
Texas A&M AgriLife Extension Service
College Station, TX
T. A. Wheeler
Texas A&M AgriLife Research
Lubbock, TX
L. D. Haynes
Texas A&M AgriLife Extension Service
Clarendon, TX

Introduction

Verticillium wilt, caused by the soilborne fungus *Verticillium dahliae* Kleb., is an economically important disease of cotton (*Gossypium hirsutum* L.) throughout the High Plains of Texas. Recent observations indicate that the disease is becoming more prevalent in areas of the Rolling Plains. Currently, management of Verticillium wilt is limited to the use of partially resistant varieties; however, little information on the performance of cotton varieties in fields infested with *V. dahliae* in the Rolling Plains are available. In addition, potassium deficiency symptoms are routinely observed towards the later part of the growing season in this region and such conditions are known to affect Verticillium wilt. The occurrence of potassium deficiency symptoms has been more common where producers are attempting to maximize yield under drought conditions (personal observation). The initial objective of this study was to evaluate the performance of cotton varieties in a field infested with *V. dahliae*; however, the opportunity arose to determine the effect of potassium deficiency-like symptoms on lint yield in presence of the disease.

Materials and Methods

The trial was conducted in in Armstrong Co. Texas (35.03562°, -101.10617°). Treatments consisted of the cotton varieties All-Tex NitroB2RF, Deltapine 0912B2RF, Deltapine 1321B2RF, FiberMax 2011GT, FiberMax 2484B2F, FiberMax 2989GLB2, NexGen 3348B2RF, NexGen 4012B2RF, Phytogen 367WRF and Phytogen 499WRF. Seed were planted at a rate of 3.2 seed per foot (on 30 in row spacing) into an Amarillo fine sandy loam on April 28, 2013. Plots were six rows wide and spanned the length of the field (~1250 feet). Treatments were arranged in a randomized complete block design with three replications. All management practices were at the discretion of the collaborating producer. The development of Verticillium wilt (Fig. 1a) was assessed throughout the growing season. Leaf samples were collected by the producer throughout the growing season and submitted to a commercial laboratory for nutrient analysis. Severe potassium deficiency-like symptoms (Fig. 1b) were observed throughout the region during the latter part of the growing season. Aerial images were collected in late August and NDVI was used to access vegetative growth. Deficiency-like symptoms were more severe on the western half of the field (Fig. 2); therefore plots were divided in half and harvested separately on October 31 and November 1. Bur cotton weights were estimated using a stationary weigh trailer equipped with digital load cells. Sub-samples were collected from each plot, ginned and sent to the Texas Tech University Fiber and Biopolymer Research Institute for quality analysis. HVI data were used to determine Common Credit Corporation (CCC) loan values, which were used to calculate gross value per acre (which took into consideration all appropriate seed and technology fees). Due to the appearance of the potassium deficiency-like symptoms, data were analysed in a split-plot manner, where crop condition (healthy or unhealthy) served as the whole plot and variety served as the sub-plot. Means were subjected to analysis of variance and separated using Fisher's Protected Least Significant Differences test ($P \leq 0.05$). Soil samples were collected from each plot following harvest and analysed for macronutrients at a commercial laboratory.

Figure 1. Verticillium wilt (top) and potassium deficiency-like (bottom) symptoms on cotton leaves from the Northern Rolling Plains.

Results and Discussion

Cool soil temperatures were experienced (data not shown) for prior to emergence and may have contributed to differences in final plant populations (Table 1). Noticeable differences in Verticillium wilt incidence (Fig. 1a) were observed in July among varieties ranging 5.3 to 19.3% (Fig. 3). Disease incidence was highest for NexGen 3348B2RF, Phytogen 499WRF and Deltapine 0912B2RF, and lowest for NexGen 4012B2RF, FiberMax 2989GLB2 and FiberMax 2484B2F. There was a substantial increase in disease incidence through early September (data not shown); however, potassium deficiency-like symptoms (Fig. 1b) confounded subsequent ratings. Deficiency-like symptoms were more pronounced on the north-western half of the field (Fig. 2). Results from in-season leaf sampling showed a depletion of potassium from mid-Jun through late Aug (Fig. 4). Plots were divided in half to compare the effect of the disorder on lint yield. Turnouts did not differ among varieties averaging 29.8% (data not shown). A significant variety × potassium status interaction was observed; therefore, yields for each variety were presented independently between the two areas (Fig. 5). Overall, yields were highest for FiberMax 2484B2F in both the deficient and healthy areas averaging 2,202 and 1,881 lb ac^{-1}, respectively. Yields for NexGen 4012B2RF, FiberMax 2989GLB2, All-Tex Nitro B2RF and FiberMax 2011GT were 553, 319, 272 and 399 lb ac^{-1}, respectively. Yields between the two areas did not differ for Deltapine 0912B2RF, Phytogen 367WRF, Deltapine 1321B2RF and Phytogen 499WRF averaging 1,353, 1,281, 1,239 and 1,199 lb ac^{-1}, respectively. Differences among varieties were observed for miconaire, length and strength (Table 1). Leaf grade values were considerably high for All-Tex Nitro B2RF, NexGen 3348B2RF and Phytogen 499WRF (data not shown), resulting in deductions that greatly affected loan value (Table 1). Gross returns were greatest for FiberMax 2484B2F ($1,082 ac^{-1}) and lowest for Deltapine 1321B2RF, Phytogen 499WRF and Phytogen 367WRF ($597-$599 ac^{-1}). Preliminary results of from soil nutrient analysis do not suggest any macro nutrients (including potassium) are limited (data not shown); however, this does explain the appearance of deficiency-like symptoms that were observed in the field. Results from this study suggest that varieties respond differently to Verticillium wilt in the Northern Rolling Plains; however, additional studies examining the interactive effect of potassium deficiency-like symptoms on variety performance are needed.

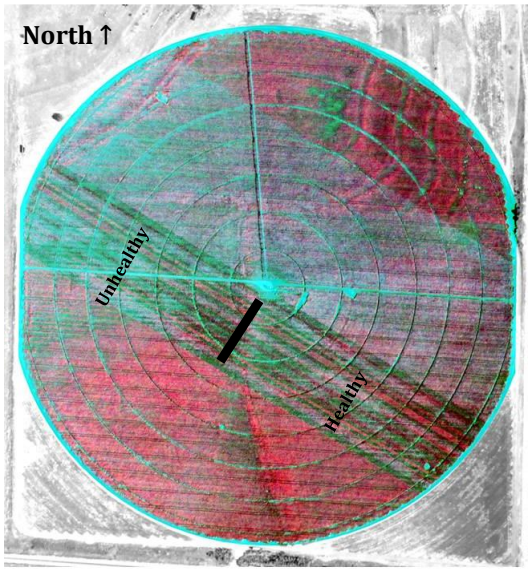

Figure 2. Near infrared aerial image of Verticillium wilt trial, illustrating varietal differences and potassium deficiency-like symptoms that developed on the western half of the field.

Table 1. Final plant populations, fiber quality parameters, loan value and net return for ten cotton varieties grown in the Northern Rolling Plains[†]

Variety	Stand (plants ft^{-1})	Mic (units)	Length (in.)	Strength (g tex^{-1})	Loan value ($ lb^{-1})	Gross value ($ acre^{-1})
All-Tex NitroB2RF	2.35 ab	3.02 ab	1.21 a	31.2 ab	0.4593 d	796 c
Deltapine 0912B2RF	1.95 bc	3.17 ab	1.10 e	29.9 de	0.4878 b-d	661 de
Deltapine 1321B2RF	2.08 bc	2.90 bc	1.12 d	30.4 b-d	0.4817 b-d	597 e
FiberMax 2011GT	2.27 ab	3.18 a	1.14 bc	30.4 b-d	0.4981 a-d	817 c
FiberMax 2484B2F	2.68 a	3.12 ab	1.21 a	30.2 d	0.5296 a	1,082 a
FiberMax 2989GLB2	2.13 bc	3.22 a	1.13 cd	29.2 e	0.5082 a-c	901 b
NexGen 3348B2RF	1.18 d	3.05 ab	1.14 bc	30.2 d	0.4773 cd	618 d
NexGen 4012B2RF	2.00 bc	3.22 a	1.15 b	31.5 a	0.5179 ab	867 bc
Phytogen 367WRF	1.65 cd	2.70 c	1.15 b	31.1 a-c	0.4673 d	599 e
Phytogen 499WRF	2.35 ab	3.20 a	1.13 cd	30.3 cd	0.4963 a-d	598 e
LSD $_{(0.05)}$	0.52	0.28	0.02	0.9	0.0395	82

[†]Means within a column are not different according to Fisher's Protected LSD. Data were pooled across healthy areas and those exhibiting potassium-like deficiency symptoms (n=6).

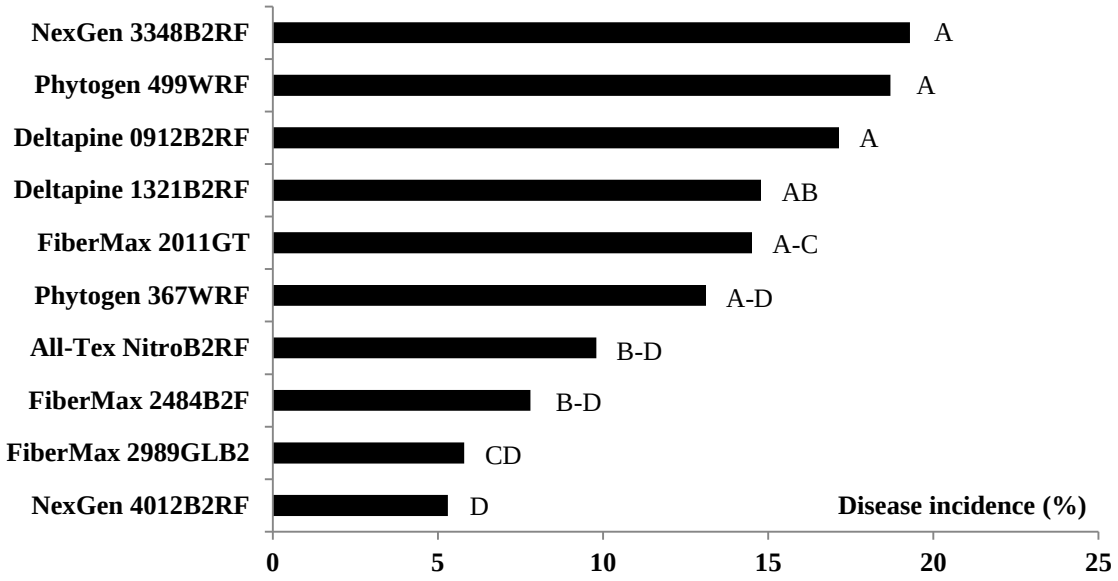

Figure 3. Early season Verticillium wilt incidence. Bars with the same letter are not different (n=3) according to Fisher's Protected LSD ($P \leq 0.05$). Data were only collected from areas not exhibiting potassium deficiency-like symptoms.

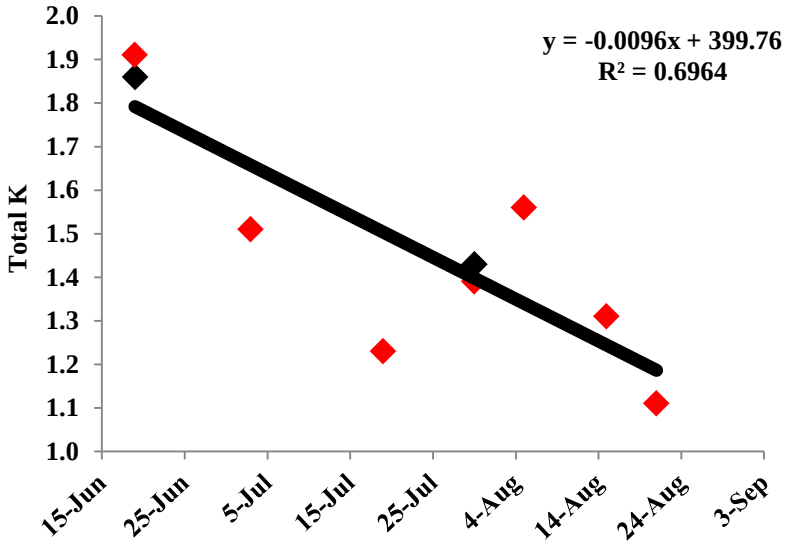

Figure 4. Status of total foliar potassium over the 2013 growing season. Red and black triangles represent Fibermax 2484B2F and Fibermax 2989GLB2, respectively.

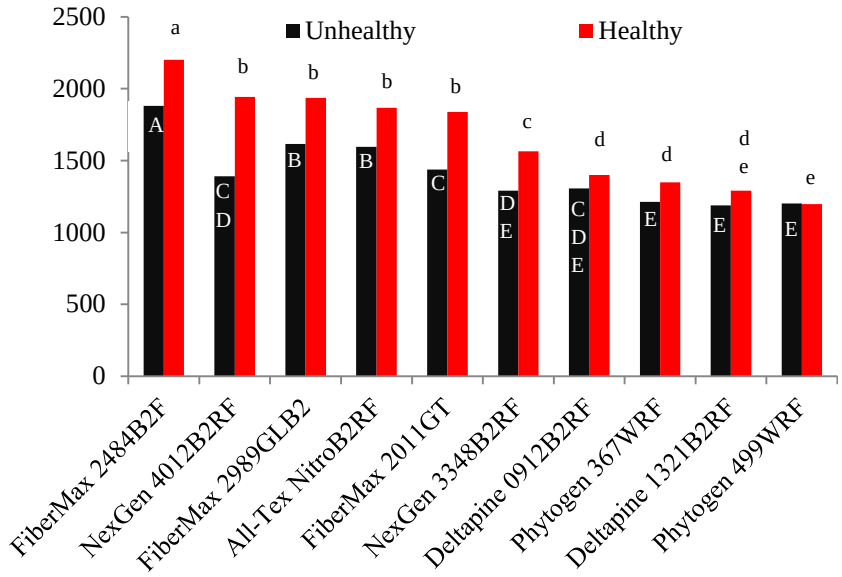

Figure 5. Lint yield of cotton varieties affected by Verticillium wilt and potassium-like deficiency symptoms (unhealthy). Black bars with the same upper case and red bars with the same lower case letters are not different ($P \leq 0.05$).