# VARIETIAL RESPONSE OF COTTON TO DISEASES IN THE TEXAS HIGH PLAINS

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## Abstract

Planting decisions should be based on various factors including agronomic properties, fiber quality factors as well as insecticide and herbicide traits. In addition, information on the response of varieties to various diseases is important. Small and large plot field studies were conducted in 2012 throughout the High Plains of Texas to evaluate the performance of commercially available varieties and advanced breeding line in fields with a history of Fusarium wilt and/or root-knot nematode. While harsh growing conditions were experienced throughout much of the season, differences in varietal performance were observed at all locations. In large plot trials, the partially resistant root-knot nematode varieties Phytogen 367WRF, Stoneville 4288B2F and Stoneville 5458B2F consistently outperformed the susceptible varieties; however, yield differences were not as obvious as in other years. Disease pressure in the small plot Fusarium wilt screening trial was moderate. Appreciable levels of plant mortality were observed in some of the more susceptible varieties. Final yields ranged from 630 to 1458 lb acre$^{-1}$ and were negatively correlated with mid-season stand counts. Plots were assayed towards the end of the growing season to compare nematode reproduction on the 20 varieties evaluated in this trial. Significant differences in reproduction were observed among varieties and genotypes. Egg plus nematode counts were greatest for All Tex 10WR585RF followed by Deltapine 1032B2RF, NexGen 3010B2RF, Phytogen 499WRF and FiberMax 9160B2F. Reproduction was lowest on Stoneville 5458B2F, Deltapine 1044B2RF and FiberMax 2011GT. Although Deltapine 1044B2RF is not known to contain any rot-knot resistance genes, circumstantial evidence exists indicating that FiberMax 2011GT may possess partial resistance. These data support such findings, thus increasing the total number of varieties commercially available for producers on the High Plains.

## Introduction

The Fusarium wilt – Root-knot nematode complex (caused by the soilborne fungus *Fusarium oxysporum* f. sp. *vasinfectum* (*Fov*) and *Meloidogyne incognita*, respectively) is an important disease of cotton (*Gossypium hirsutum* L.) in parts on the High Plains of Texas. Shepherd et al., 1986 indicated that management of the disease could be achieved by using varieties possessing partial resistance to the fungus or the nematode. Trials evaluating the performance of cotton varieties in fields infested with the two aforementioned pathogens have been conducted over the past five years (Batla et al. 2008; Woodward and Wheeler, 2010). The consistent performance of varieties, such as Deltapine 174RF, Stoneville 4554B2RF Stoneville 4288B2F and Stoneville 5458B2F, have provided producers with reliable planting options; however, the discontinuing of varieties or seed availability may limit such options. Chawla et al. (2011) found that planting a partially resistant variety for three years reduced populations of *Fov* compared to growing a susceptible variety for the same period of time. The increased number of varieties being released also affects producer decisions, thus interest remains in the cotton variety screening programs. Additional studies in the region have shown variety selection is the most effective and least costly option for managing Verticillium wilt, caused by the soilborne fungus *Verticillium dahliae* (Wheeler and Woodward 2008, 2009, 2010 and 2011). Other management options consist of crop rotation and fumigation (Colyer et al., 1997); however, the effect of these practices on the disease is erratic and costly. In-furrow applications of the nematicide Temik 15G (aldicarb, Bayer CropScience, Research Triangle Park, NC) are effective at reducing losses due to both *M. incognita* (Colyer et al., 1997) and *Fov* (Wheeler and Gannaway, 2005); however, the product is no longer on the market as of 2012. The objective of this study is to evaluate the response of cotton varieties and breeding lines to Fusarium wilt and/or the root-knot nematode.

## Materials and methods

Large plot field trials were conducted in Gaines and Lubbock counties to evaluate the performance of several commercially available varieties in fields with a history of Fusarium wilt and/or the root-knot nematode. Irrigation capacity and method differed for each location. In Lubbock County, the trial was established in a row watered field

with low irrigation capacity; whereas, the trial conducted in Gaines County was planted under a pivot with moderate irrigation capacity. A small plot trial consisting of 20 entries was established under pivot irrigation in a field with a severe history of Fusarium wilt. All trials were planted at a rate of four seed per foot during the middle to latter part of May. Seed treatment nematicides were applied to seed evaluated in the small plot trials, but not large plot trials. All management practices were at the discretion of the cooperating producer. Stand counts were determined approximately 30 days after planting. Disease incidence was accessed routinely in the Fusarium wilt trial. Plots were harvested at maturity between Oct-20 and Nov-8. Data were analyzed using analysis of variance and means were separated using Fisher's Protected LSD ($P \leq 0.05$). Regression analysis was performed on data from the small plot trial to determine the relationship between plant mortality due to Fusarium wilt and lint yields.

## Results and discussion

Environmental conditions in 2012 for much of the High Plains were not conducive for Fusarium wilt or root-knot nematodes. High temperatures throughout much of the growing season resulted above average (+15.5%) compared to the 30 year average (Fig. 1). In addition, lower than average rainfall occurred in all months, except August (Fig. 2). Despite harsh growing conditions, differences in lint yield were observed among the varieties evaluated in the large plot trials. In Gaines County, yields ranged from 979 to 1250 lb acre$^{-1}$ for the susceptible FiberMax 9160B2F and partially resistant Stoneville 4288B2F, respectively (Table 1). Yield for Phytogen 367WRF was intermediate (1115 lb acre$^{-1}$); whereas, Stoneville 5458B2F performed similar to Deltapine 1044B2RF, Phytogen 499WRF and FiberMax 9160B2F. Yields at the Lubbock location averaged 376 lb acre$^{-1}$ as a result of the amount of irrigation available at this location (Table 2). Stoneville 5458B2F and Stoneville 4288B2F performed similarly yielding just under a bale to the acre. FiberMax 9170B2F and Phytogen 367WRF performed similar to Stoneville 4288B2F and better than NexGen 4010B2RF. Poor stand establishment was observed for Deltapine 1032B2F (data not shown) and this may have contributed to the lower yields (211 lb acre$^{-1}$) observed with this variety.

Mid-season plant populations and lint yields differed among the 20 varieties in the small plot Fusarium wilt trial conducted in Lubbock County (Table 3). Differences in plant stand between the varieties 21 days after planting were minimal (data not shown); however, mortality due to Fusarium wilt was obvious by the mid-season rating. Stands were greatest for Phytogen 339WRF (3.6 plants foot$^{-1}$) and lowest for Deltapine 1032B2RF, All Tex 10WR585RF, Deltapine 1050B2RF and Deltapine 1133B2RF (averaging 1.3 plants foot$^{-1}$). Lint yields ranged from 629.8 to 1457.7 lb acre$^{-1}$ and were found to be negatively correlated ($y=-10.6x+1540.8$; $R^2=0.7115$, $P<0.01$) with plant mortality (Fig. 3). Nematode reproduction was observed on all varieties planted; however, differences among varieties were found (Table 3). The total number of second stage juveniles was highest for the susceptible check FiberMax 9160B2F and lowest for the partially resistant check Stoneville 5458B2F. Egg production (per 500cc soil) on the varieties ranged from 390 to 10110 for Stoneville 5458B2F and All Tex 10WR585RF, respectively. Considerable variation was observed among other varieties including the known partially resistant variety Phytogen 367WRF. Combined egg and juvenile counts, were greatest for All Tex 10WR585RF followed by Deltapine 1032B2RF, NexGen 3010B2RF, Phytogen 499WRF and FiberMax 9160B2F and lowest on Stoneville 5458B2F, Deltapine 1044B2RF and FiberMax 2011GT. Although Deltapine 1044B2RF is not known to contain any rot-knot resistance genes, circumstantial evidence exists indicating that FiberMax 2011GT may possess partial resistance.

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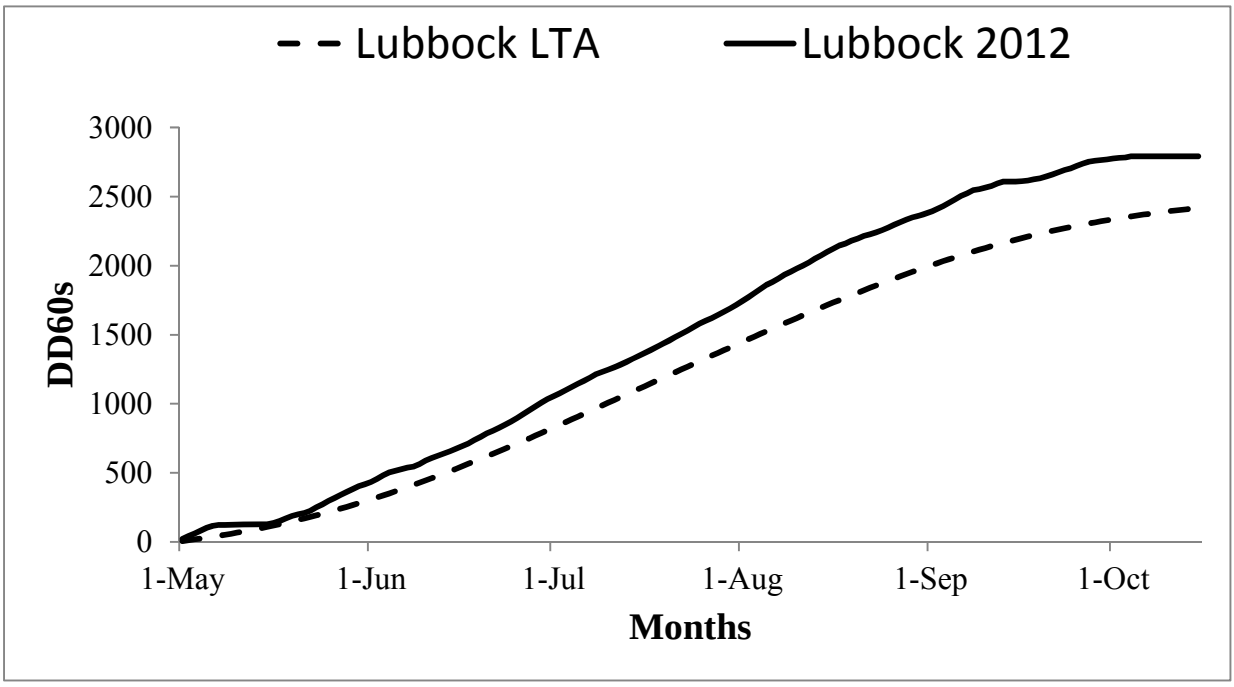


**Figure 1.** Accumulation of heat units for Lubbock, TX in 2012 (solid line) and the 30 year long term average, LTA (dashed line).

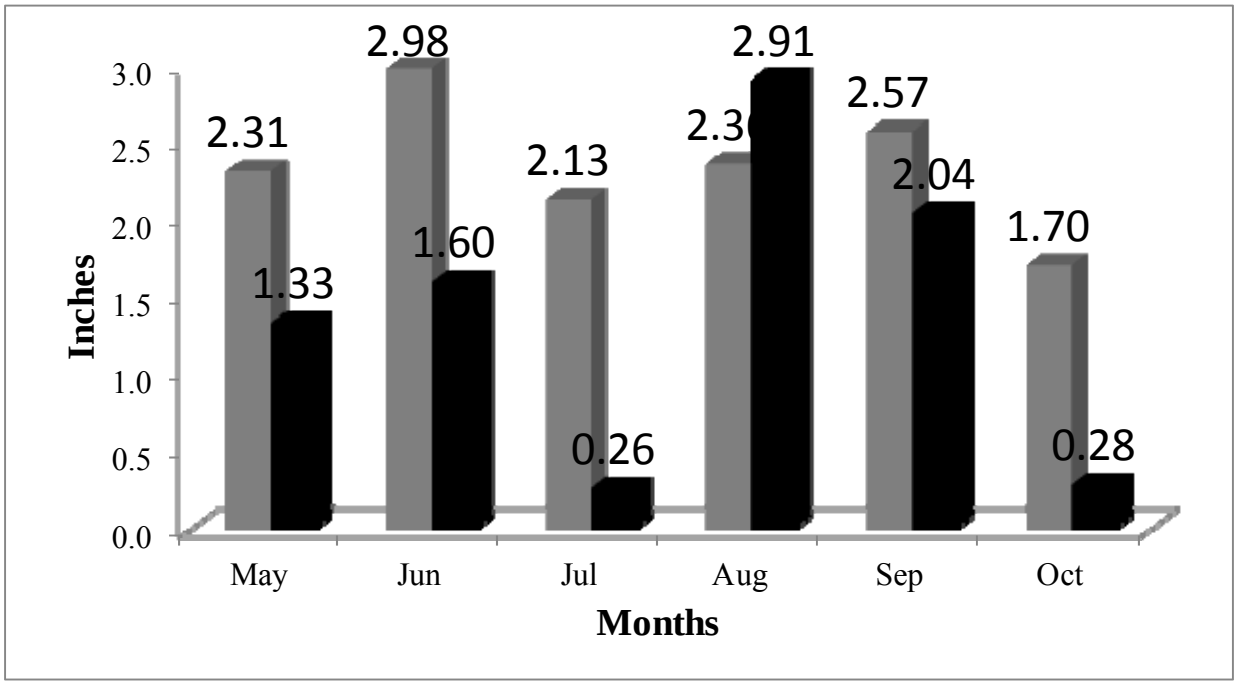


**Figure 2.** Rainfall totals for Lubbock, TX in 2012 (black bar) and the 30 year long term average, LTA (gray bar), May through October.

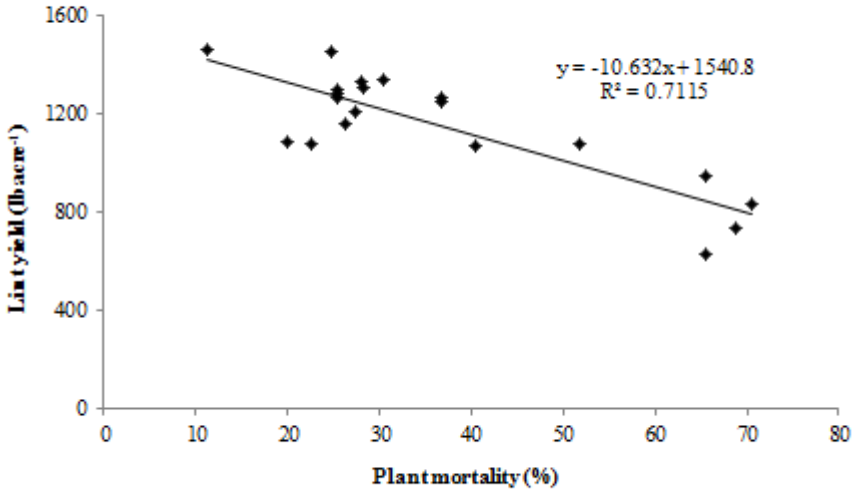


**Figure 3.** Negative relationship between lint yield of cotton varieties and plant mortality resulting from Fusarium wilt, Lubbock County (2012).

**Table 1.** Lint yield of cotton varieties grown in a field infested with root-knot nematodes in Gaines County Texas in 2012

| Variety | Lint yield (lb acre$^{-1}$) |
|---|---|
| Stoneville 4288B2F* | 1250 a+ |
| Phytogen 367WRF* | 1115 b |
| Deltapine 1044B2RF | 1042 c |
| Stoneville 5458B2F* | 1019 c |
| Phytogen 499WRF | 991 c |
| FiberMax 9160B2F | 979 c |

*Denotes varieties with partial resistance to root-knot nematodes.

+ Data are the means of four replications. Values within a column followed by the same letter are not different according to Fisher's Protected LSD ($P \leq 0.05$).

**Table 2.** Lint yield of cotton varieties grown in a field infested with root-knot nematodes in Lubbock County Texas in 2012

| Variety | Lint yield (lb acre$^{-1}$) |
|---|---|
| Stoneville 5458B2F* | 500 a+ |
| Stoneville 4288B2F* | 443 ab |
| FiberMax 9170B2F | 410 b |
| Phytogen 367WRF* | 376 bc |
| NexGen 4010B2RF | 318 c |
| Deltapine 1032B2RF | 211 d |

*Denotes varieties with partial resistance to root-knot nematodes.

+Data are the means of four replications. Values within a column followed by the same letter are not different according to Fisher's Protected LSD ($P \leq 0.05$).

**Table 3.** Stand counts, lint yields and nematode reproduction for 20 cotton varieties planted in a small plot Fusarium wilt trial in Lubbock County, 2012*

| Variety | Stand (plants/ft) | | Lint yield (lb acre$^{-1}$) | | Nematode Eggs+ | | Nematode juveniles+ | |
|---|---|---|---|---|---|---|---|---|
| Phytogen 339WRF | 3.6 | a | 1458 | a | 3090 | bcd | 270 | abc |
| Deltapine 1212B2RF | 3.0 | bc | 1454 | ab | 1920 | bcd | 160 | abcd |
| Stoneville 5458B2F | 2.8 | bc | 1340 | ab | 390 | d | 85 | d |
| Deltapine 1219B2RF | 2.9 | bc | 1332 | ab | 1920 | bcd | 195 | abcd |
| Deltapine 1044B2RF | 2.9 | bc | 1304 | ab | 660 | cd | 140 | bcd |
| FiberMax 2989B2F | 3.0 | bc | 1298 | ab | 2130 | bcd | 275 | ab |
| Phytogen 499WRF | 3.0 | bc | 1279 | ab | 3750 | bc | 95 | cd |
| NexGen 1511B2RF | 2.5 | c | 1265 | ab | 1380 | bcd | 205 | abcd |
| All Tex Dinero B2RF | 3.0 | bc | 1262 | ab | 1650 | bcd | 135 | bcd |
| FiberMax 2011GT | 2.5 | c | 1248 | ab | 870 | cd | 120 | bcd |
| Phytogen 367WRF | 2.9 | bc | 1204 | abc | 1530 | bcd | 115 | bcd |
| FiberMax 9160B2F | 3.0 | bc | 1158 | bc | 3210 | bcd | 320 | a |
| FiberMax 2484B2F | 3.2 | ab | 1084 | bcd | 1800 | bcd | 230 | abcd |
| FiberMax 1944B2F | 3.1 | ab | 1076 | bcd | 1740 | bcd | 265 | abc |
| Deltapine 1137B2RF | 1.9 | de | 1074 | bcd | 1470 | bcd | 190 | abcd |
| NexGen 4010B2RF | 2.4 | cd | 1064 | bcd | 3660 | bc | 175 | abcd |
| Deltapine 1032B2RF | 1.4 | ef | 943 | cde | 4260 | b | 190 | abcd |
| All Tex 10WR585RF | 1.2 | f | 834 | def | 10110 | a | 250 | abcd |
| Deltapine 1050B2RF | 1.3 | f | 732 | ed | 2880 | bcd | 250 | abcd |
| Deltapine 1133B2RF | 1.4 | ef | 630 | f | 2250 | bcd | 120 | bcd |

*Data are the means of four replications. Values within a column followed by the same letter are not different according to Fisher's Protected LSD ($P \leq 0.05$).

+Estimates of root-knot nematode eggs and second stage juveniles were made from 500cc soil samples in late September.