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Managing Fusarium and Verticillium Wilts of Cotton

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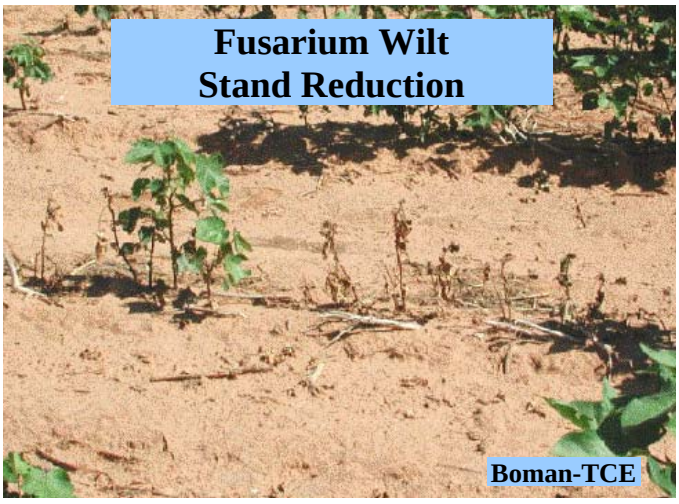
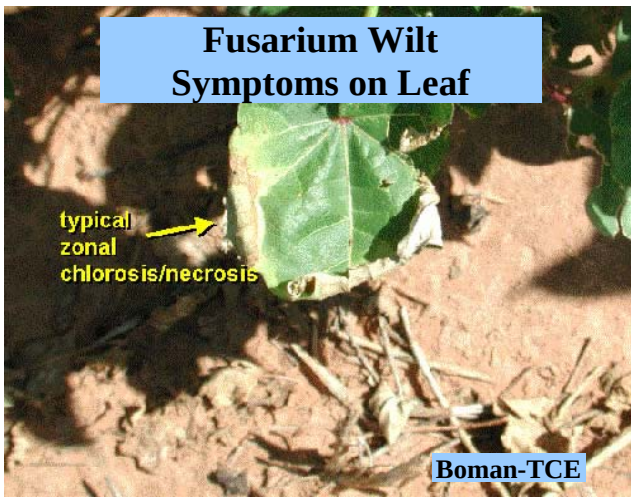
Wilt disease can be one of the most devastating problems in cotton. **Fusarium wilt** (which is caused by the fungus *Fusarium oxysporum* f.sp. *vasinfectum*) is most commonly found in the southern counties of the southern High Plains (Dawson, Terry, and Gaines counties). **Verticillium wilt**, which is caused by the fungus *Verticillium dahliae*, can be found throughout the High Plains. A third type of wilt, called **bronze wilt**, is rarely seen at all in the High Plains, though it can occur commonly in other parts of Texas. This wilt is not well understood, and may not even be disease related. However, like other wilts, losses can be quite severe when it occurs (which is usually late in the growing season).

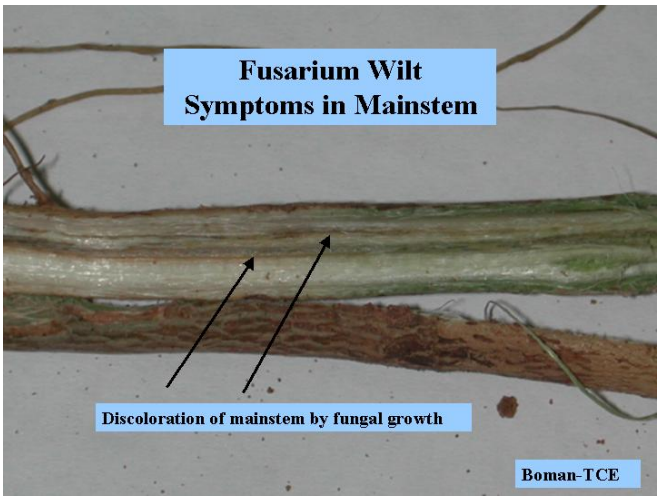
Fusarium wilt

Symptoms: Fusarium wilt, under high inoculum pressure, will start to show symptoms during the late seedling phase. By about 30 to 40 days after planting, plants will die. Even the survivors may have





severe hypocotyl lesions that can be mistaken for damage by the seedling disease pathogen, *Rhizoctonia*. Wind damage can also be confused with early season Fusarium wilt. There is a need to look carefully to distinguish the cause of seedling death.



Later in the season, leaves show a distinct loss of turgor and yellowing occurs starting at the leaf margin between the main veins. The yellowing progresses inward and is followed by necrosis. Defoliation occurs starting at the bottom of the plant, and working towards the top. In severe cases, plant death can occur. Generally, the vascular discoloration with Fusarium wilt is a solid dark brown ring around the outer portion of the stem, when seen in cross section.

Epidemiology and Management: Fusarium is a warm-temperature disease; as such it would not be as likely to occur during a cool spring. The fungus is soil borne, so any movement of soil from an infested field can infest a new field. Soil is easily moved by farm equipment, custom harvesters, muddy pickup trucks and muddy boots. Fusarium can survive in the soil for long periods on organic matter and non-host plant roots. It can enter roots through wounds or penetrate the root cells directly.

The degree of disease symptoms is related to the amount of inoculum in the soil. In the absence of root-knot nematode, it may take 10 times as much inoculum to show disease symptoms, as in the presence of root-knot nematode. Often higher amounts of inoculum are also associated with earlier symptom development. Fusarium wilt is also favored by sandy soils, nitrogen fertilizers, especially ammoniacal nitrogen.

The ability of the fungus to survive extended periods without cotton limits the effectiveness of rotation. However, rotation to peanut to reduce root-knot nematode populations can be effective. The use of nematicides (Temik 15G at 5-7 lbs/acre in the furrow at planting)

Response of 30 varieties to Fusarium wilt. Dawson Co. 2004

Cultivar	lbs of lint/a	% Survival at 47 days compared with 29 days after planting	% Survival at 114 days compared with 29 days after planting
PM 2280 BG/RR	**1,361 a**	**71 ab**	**61 a-d**
FM 960 BR	**1,355 a**	57 d-g	43 g-j
PM 2379 RR	**1,355 a**	**69 abc**	58 a-e
ST 5599 BR	**1,320 ab**	47 g-j	42 g-j
All-Tex Atlas	**1,305 abc**	**74 a**	**59 a-d**
ST 2454 R	**1,289 abc**	60 c-f	56 b-f
PM 2167 RR	**1,279 a-d**	64 a-d	**59 a-d**
ST LA 887	**1,266 a-d**	**70 abc**	**65 ab**
ST 3539 BR	**1,266 a-d**	62 b-e	56 b-f
FM 989 BR	**1,208 a-e**	50 f-j	44 f-i
All-Tex Top-pick	**1,206 a-e**	57 d-g	52 c-g
All-Tex Atlas RR	**1,181 a-f**	**74 a**	**59 a-d**
DP 5415 RR	1,137 b-g	57 d-g	50 d-g
All-Tex Excess RR	1,107 c-h	**70 ab**	**63 ab**
TAMCOT Sphinx	1,080 d-h	41 ij	35 h-k
All-Tex Xpress	1,024 e-i	**67 abc**	**63 abc**
AFD 2485	1,018 e-i	50 f-j	38 h-k
AFD 3511 R	996 f-i	**73 a**	**59 a-d**
AFD 2428	985 f-i	55 d-g	46 f-i
ST 4793 R	964 ghi	55 d-g	42 g-j
DP 555 BG/R	964 ghi	51 f-i	42 g-j
ST 4892 BR	960 ghi	53 efg	44 g-j
FM 958	955 ghi	48 g-j	35 ijk
PM 2326 RR	935 ghi	**72 ab**	**68 a**
BCG 24R	906 hij	53 e-h	42 g-j
FM 966	869 ij	43 hij	32 jk
BCG 30R	847 ijk	53 efg	44 ghi
BCG 28R	823 ijk	52 fgh	47 e-h
FM 819	712 jk	47 g-j	37 h-k
FM 832	657 k	40 j	29 k
Minimum sign. diff.	205	10	12

Bold letters indicate best variety for each parameter measured

affects root-knot nematode, which indirectly will reduce the incidence of Fusarium wilt.

Yields were improved by an average of 26% in a Fusarium wilt field in Dawson County, when using Temik 15G on 30 different varieties. However, the biggest improvement in yield was based on variety selection. Some varieties are far more resistant than others to Fusarium wilt. Fusarium wilt can also be present in the cottonseed, so these fields cannot be used for commercial seed production. The recent increase in problems with Fusarium wilt may be related to the varieties grown in any one year, but also to the variety history over the last few years. Most fields that had problems in 2003 and 2004 with Fusarium wilt had a 2-3 year history of growing very susceptible varieties. The Fusarium wilt inoculum apparently had to increase over several years for a problem to be noticed.

Verticillium wilt

Symptoms: Leaf symptoms most frequently occur from the beginning of flowering to the end of the growing season. The chlorosis followed by necrosis of the leaves are similar to that found in Fusarium wilt, and may appear differently for different varieties. Usually Verticillium wilt does not cause

disease symptoms in the seedling stage. Verticillium wilt has dark brown to black streaks through the center of the stem when cut diagonally. When cut longitudinally, vascular discoloration can look continuous. While these streaks may be more discontinuous than those found with Fusarium wilt, there are often exceptions to these general differences in symptoms. Therefore, disease identification should be confirmed through isolation of the causal fungus in the laboratory. It is especially important in regions that can get both types of wilt to confirm which type is present.

Epidemiology and Management: When cool temperatures occur in July or August, Verticillium wilt can be extremely damaging to yield. Cool weather in July, can lead to symptoms around the time of first flower, or even earlier. Generally, Verticillium wilt develops faster as the maximum daily temperature is reduced from 95 F. Verticillium wilt will stop progressing once daily maximum temperature exceeds 95 F. The loss of yield can be correlated with earlier symptom development, but it also depends on whether the cool temperatures hold throughout the summer. Very often a cool July initiates Verticillium wilt symptoms, but if followed by a hot August, then little yield loss occurs.

Wilt severity can be rated on a scale of 0 to 3, with 0 = no wilt, 1 = wilt in the bottom ½ of the plant, 2 = wilt progressing to the top ½ of the plant, and 3 = total defoliation and a dead plant. It is recommended to rate for Verticillium wilt incidence and severity several times during the season, starting in late July, followed by mid August, and the end of August or early September.

Verticillium wilt also causes reductions in fiber quality. Immature fibers are increased, while fiber length, strength, uniformity and grade are decreased. The fungus can survive in the soil as microsclerotia for as long as 10 years. The microsclerotia germinate in response to cotton root exudates. High soil water content from rain or irrigation decreases soil temperature and increases disease incidence and severity. Microsclerotia form during the winter months in undecomposed plant material. The use of gin trash as a source of organic matter can introduce microsclerotia to the field.

Verticillium wilt trial conducted in Halfway, TX in 2004.

Variety	% of plants with wilt as a ratio of Lankart 57	Resistance rating
Lankart 57 (susceptible check)	100 a	Highly susceptible
Stoneville 2448 R	54.2 b	Susceptible
Phytogen 410 R	53.4 bc	Susceptible
Beltwide Cotton Genetics 50R	45.8 bcd	Susceptible
Paymaster HS-26	44.0 b-e	Susceptible
Stoneville 5303R	43.3 b-f	Susceptible
FiberMax 989 RR	33.1 d-h	Partially resistant
H&W Genetex 520 RR	32.6 d-h	Partially resistant
FiberMax 989 BR	32.6 d-h	Partially resistant
FiberMax 960 RR	27.5 e-h	Partially resistant
FiberMax 960 BR	24.9 ghi	Partially resistant
Minimum Significant difference (0.05)	17.8	

Control of Verticillium wilt requires an integrated approach. Varietal resistance is the best place to begin. Because the weather has been hot and dry during August from 1998 through 2003, only in 2004 was it possible to record substantial differences between varieties in the Lubbock and Halfway Verticillium nurseries. As a result we do not have a comprehensive list of varieties ranking them with Verticillium wilt resistance.

Some cultural practices can be directed against Verticillium, although the impact is minimal in a year with bad wilt. These practices include: raising planting beds, improving drainage, using adequate, but not excessive irrigation and nitrogen fertilizer. More water leads to lower yields in a Verticillium wilt field! A high plant density may also reduce wilt severity compared with a lower plant density. When either Fusarium or Verticillium wilt becomes sufficiently bad, no further resources should be directed to that field. Wilt fungi block up the vascular system of cotton. The blockage cannot be removed, so once the plant is no longer receiving water and nutrients through the root system, it is a waste of money to continue watering the field. This decision can be trickier with Verticillium wilt, because an increase in temperature will stop progress of the wilt.

Bronze wilt

There is much about bronze wilt that is not understood. In fact it is not known for sure what causes bronze wilt. There are major differences between bronze wilt and Fusarium and Verticillium wilt. The purpose of this section is not to describe bronze wilt in detail, but to point out the differences between bronze wilt, Fusarium wilt, and Verticillium wilt. Bronze wilt occurs infrequently in the High Plains of Texas, but much more frequently in the rest of the state. It requires higher nighttime temperatures than are usually found in west Texas. It comes in late in the season (usually in the last 2 weeks of August) in the areas near Big Spring. The wilt starts from the top of the plant, with the leaves exhibiting a distinct lack of turgor. Leaves may also have a bronze shade. There generally is not vascular discoloration. The problem occurs in specific varieties, and is usually more severe in fields pushed for high and early yields. One solution is to grow bronze wilt tolerant varieties. Many picker-type varieties are now listed as to their sensitivity to this problem in the company brochures. Some areas of the country that have associated nutrient deficiencies with this problem, recommend using potassium or phosphorus to correct the problem. **Application of potassium or phosphorus on fields with Verticillium or Fusarium wilt will not correct those disease problems.**

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