

Resistance to Fusarium Wilt Pathogen in Currently Used Cotton Cultivars

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ABSTRACT

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A number of cotton (*Gossypium hirsutum*) cultivars were evaluated and compared with checks, one susceptible and one resistant to both the wilt fungus (*Fusarium oxysporum* f. sp. *vasinfectum*) and root-knot nematodes (*Meloidogyne* spp.). Based on mean wilting during the last 3 yr, 10 cultivars with tolerance or good resistance to this fungus-nematode complex were identified. Although none was as resistant as the Auburn BR2 check, five cultivars (Deltapine 55, McNair 220, Delcot 311, Rex 713, and Stoneville 603) were highly tolerant.

Fusarium oxysporum Schlecht. f. sp. *vasinfectum* (Atk.) Snyd. & Hans., the causal agent of Fusarium wilt of cotton (*Gossypium* spp.), and the relationship of this pathogen to root-knot nematodes (*Meloidogyne* spp.) were described by Atkinson (1) in 1892. Immunity to this fungus-nematode complex, however, has not been developed. Differences in resistance within and between cottons have been reported by a number of workers (3-7,10,11). In the early 1900s,

sources of resistance to the pathogens were studied and utilized in efforts to incorporate this resistance into usable germ plasm of both upland (*G. hirsutum* L.) and Sea Island (*G. barbadense* L.) cottons (8). Some progress was made in developing resistance to the complex in varieties with fair yield and fiber properties. The first big improvement did not occur until 1942 when Coker 100 Wilt, a cultivar with a combination of acceptable agronomic traits and moderate resistance to the wilt-complex pathogens (9), was released.

Higher levels of resistance to the pathogens and better agronomic performance, however, have been incorporated into several commercial cultivars (5). Greater progress in developing cotton cultivars with a combination of the needed agronomic traits and resistance to

the Fusarium wilt pathogen would occur if selections for all of these traits could be made concurrently. Unfortunately, this practice is not followed because favorable field sites to screen large segregating populations for resistance to the Fusarium wilt pathogen are rare and not available to most cotton breeders.

Many of the strains and most of the cotton cultivars used across the Cotton Belt have been evaluated annually at Tallahassee, AL, in the Regional Fusarium Wilt Test. However, the incidence of wilt varies over years and within the experimental area during a given year. In addition, symptom expression is also influenced and compounded by the presence and numbers of root-knot nematodes in the soil. Nematode populations and activities also vary over years and across large experimental fields. Mean wilting measurements over several years, therefore, are necessary to accurately characterize potential resistance to the wilt-complex pathogens.

The objectives of this study were to evaluate commercial cultivars for resistance to the *Fusarium-Meloidogyne* pathogens and to compare this resistance among cultivars by measuring wilting over a number of years.

MATERIALS AND METHODS

The materials evaluated in this study

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Table 1. Percentage of cotton plants expressing wilt symptoms when grown on soil highly infested with *Fusarium oxysporum* f. *vasinfectum* and *Meloidogyne* root-knot nematodes, Tallassee, AL

Cultivar	Mean wilting over years (%)									
	1980	2 yr	3 yr	4 yr	5 yr	8 yr	9 yr	11 yr	12 yr	14 yr
		1979-1980	1978-1980	1977-1980	1976-1980	1973-1980	1972-1980	1970-1980	1969-1980	1967-1980
Hurley's Rowden ^a	70	72	66	72	70	67	67	72	74	76
Auburn 56	34	31	24	22	18	23	21	23	22	20
Stoneville 213	69	66	50	49	42	47	45	50	53	56
Coker 310	35	35	27	26	23	25	24	26	25	...
Stoneville 603	30	25	20	22	18	19	19	24	23	...
Deltapine 55	26	22	16	19	17	22	22	...	...	...
Coker 304	38	30	24	22	19	23	23	...	...	...
Hancock	61	57	52	52	48	53	...	...	...	...
Auburn BR 2 ^b	15	13	13	12	12	13	...	...	...	...
Deltapine 26	42	34	25	20	16	...	...	...	...	...
Deltapine 61	30	28	21	19	19	...	...	...	...	...
McNair 220	31	23	18	18	15	...	...	...	...	...
Vail 7	54	50	42	41	39	...	...	...	...	...
Coker 315	44	35	26	26	...	...	...	...	...	...
Coker 420	37	27	20	21	...	...	...	...	...	...
Coker 3114	40	28	23	24	...	...	...	...	...	...
Rex 713	24	21	17	19	...	...	...	...	...	...
McNair 235	26	21	17	...	...	...	...	...	...	...
Deltapine 41	52	39	29	...	...	...	...	...	...	...
Delcot 311	25	20	16	...	...	...	...	...	...	...
GaCot 79	29	27	20	...	...	...	...	...	...	...
DES 56	36	29	...	...	...	...	...	...	...	...
Stoneville 825	83	67	...	...	...	...	...	...	...	...
DES 24	42	32	...	...	...	...	...	...	...	...

^aCheck susceptible to the pathogens.

^bCheck resistant to the pathogens.

were part of the Regional Fusarium Wilt Test. This test, which includes advanced strains and cultivars of cotton submitted by researchers from across the entire Cotton Belt, has been conducted annually for the past 30 yr. It is conducted at the Alabama Agricultural Experiment Station Plant Breeding Unit at Tallassee. The soil in the specific field used for this test is a Wickham sandy loam, a member of the fine-loamy, mixed thermic family of Typic Hapludults. The high infestation levels of *F. oxysporum* f. sp. *vasinfectum* and *Meloidogyne* spp. in this soil were maintained by using a rotation of a cotton cultivar (Hurley's Rowden) susceptible to both the Fusarium wilt pathogen and root-knot nematodes and a fall planting of hairy vetch (*Vicia villosa* Roth), which is highly susceptible to root-knot nematodes. Cultivars were arranged in a systematic design with Hurley's Rowden included annually as a gradient check every 10th row within the test. From 1973-1980, Auburn BR2 was used as a check resistant to the pathogens. Single-row plots (1 × 9.1 m) were planted with a cone-type planter using 200 seeds per plot.

From 1967 through 1971, plants with wilt symptoms of any type were removed and counted every 10-14 days throughout the growing season. Symptomless plants were counted at the end of the growing season. From 1972 through 1980, initial live-plant counts were made after losses from seedling diseases had occurred and again near the end of the season. One to three inspections were made during the interim, and wilted plants were removed and recorded.

Plants manifesting symptoms from infection by the wilt fungus and nematode infection were not differentiated from those just infected with the wilt fungus. All were recorded as wilted.

From 1967 to 1971, total wilting was determined by adding plants removed over all dates, but from 1972 to 1980 total wilting was determined as the difference between initial and final live-plant counts. Percentage of wilting per plot was determined, and mean wilting for a given entry was then determined. Where a given cultivar was entered by more than one cooperator, mean wilting was calculated over all plots.

RESULTS AND DISCUSSION

Nine of the cultivars tested (Deltapine 55, McNair 220, Delcot 311, Rex 713, Stoneville 603, Deltapine 61, McNair 235, Ga-Cot 79, and Coker 420) were tolerant to the Fusarium wilt pathogen when grown in soil heavily infested with both the wilt organism and root-knot nematodes (Table 1). However, only six of these cultivars have been evaluated extensively and only two of these (McNair 235 and Delcot 311) also possess desirable agronomic properties (2). Seed of two of these cultivars (Rex 713 and Stoneville 603) are no longer available commercially. With the exception of Deltapine 61 and possibly Deltapine 55, none of the above cultivars is grown extensively over the Cotton Belt, for several reasons: a) This degree of resistance to the pathogens is not needed because fields highly infested with *F. oxysporum* f. sp. *vasinfectum* are avoided; b) several of these cultivars have

been available to growers for only 2 yr; and c) greater profits (higher yields) can be made using other cultivars.

Several cultivars (Stoneville 213, Hancock, Vail 7) evaluated for a number of years were consistently susceptible to the *Fusarium-Meloidogyne* pathogens. Stoneville 825 has been tested for only 2 yr but also appears highly susceptible to the pathogens. Stoneville 213 has been grown extensively in areas of Alabama where losses from Fusarium wilt do not normally occur. Based on growers' projections, Stoneville 825 will be planted in these areas during 1981 (L. Chapman, *personal communication*).

None of the cultivars tested was as resistant to the *Fusarium-Meloidogyne* pathogens as Auburn BR2, although all were superior to it in agronomic properties. Thus, efforts to combine the high levels of resistance into cultivars containing good agronomic properties must be continued.

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