UPLAND COTTON VARIETAL RESPONSE TO CHARCOAL ROT

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Abstract

Eight cotton, Gossypium *hirsutum* L., cultivars or breeding-lines were evaluated for relative susceptibility to charcoal rot, which is caused by *Macrophomina phaseolina* (Tassi) Goidanich. The cultivars were Texas 121, AP 4103, AP 6101, and Stoneville 474 and the experimental breeding-lines were DG 2165, DG 2108, DG 2383, and DG 2387. On 26 July, wilting and death of cotton plants was noticed. *Macrophomina phaseolina* was identified by the presence of the sclerotia on the roots of affected plants. On 30 August 1999, the disease incidence was evaluated within in 4-meter section of each of two rows within each plot. The cotton was hand-harvested from 4-meter long sections on 5 October, and seed cotton and lint weights were taken. Disease incidence was lowest in AP 6101, followed by AP 4103; all other entries preformed similarly, P£0.05. AP 6101 had a higher yield than all other genotypes except for AP4103 and DG 2108. There was a correlation between disease incidence and yield (r= 0.8499: $p < 0.01$).

Introduction

Charcoal rot, which is caused by *Macrophomina phaseolina* (Tassi) Goidanich, can be severe under conditions of drought stress and high temperature (Bruton et al. 1987). *M. phaseolina*, a soil-borne fungus, invades roots or lower stems, colonizes internal tissues quickly, and the plant wilts and dies (Watkins 1981). The small, black sclerotia that are embedded in affected tissue are diagnostic for this disease (Watkins 1981).

Fumigants, solarization and deep plowing have had little success in controlling charcoal rot and crop rotation is not practical due to the wide host range of *M. phaseolina* (Bruton and Wann 1988). However, charcoal rot appears to affect some cotton varieties less severely than others (Watkins 1981).

Materials and Methods

In March 1999, seeds of eight cotton genotypes were sown at the University of California Desert Research and Extension Center, Holtville, CA. The experimental design was a randomized complete block with four replications. Each plot was 14 meters long and 8 meters wide. The varieties compared were as follows: Texas 121 (Stoneville Pedigree Seed Co.), Stoneville 474 (South Texas Planting Seed Co.), AP 4103 (AgriPro Seed) and AP 6101 (AgriPro Seed); and experimental seed-lines from United Agri Products were DG 2108, DG 2165, DG 2383 and DG 2387.

The cotton plants were water stressed during mid-July, while daily high air temperatures were between 39.4 and 41.7°C (CIMIS). The field was furrow irrigated on 21 July. Leaf death and wilting was observed on 26 July. By 15 August, dead leaves had abscised and some plants were producing new growth, other plants were obviously dead.

The disease was identified by the presence of the sclerotia on the roots of affected plants. To verify that there was a constant association between the fungus and the symptoms, from 9 to 21 September, 4-5 plants each apparently healthy, prematurely defoliated and dead were uprooted from each plot and the roots were examined for sclerotia. Only healthy plants were sampled from plots in which plants were not exhibiting above ground symptoms.

On 30 August, counts were taken of defoliated plants with young growth, dead and total plants present in 4-meter section of each of two rows within each plot. Seed cotton was hand picked from 4-meter sections of row on 5 October. Seed cotton weights were recorded, samples were ginned and lint weights were recorded. Disease incidence, and yield were analyzed using ANOVA (MSTAT-C 1989). Student-Newman-Keul's Multiple Range Test was used to separate means.

Results and Discussion

M. phaseolina sclerotia were associated with the symptoms observed. Sclerotia were present on the roots of all dead plants sampled, on 32.6 % of defoliated plants with re-growth and on 0.7 % of the plants with no above-ground symptoms when examined 9 to 21 September (Table 1).

Disease incidence was lowest in AP 6101 (0.0 %), followed by AP 4103 (6.8%); other entries preformed similarly, $P \leq 0.05$ (Table 2). The pathogen killed fewer AP 6101 (0.0 %) plants than other genotypes tested except AP 4103 (1.8 %), Stoneville 474 (4 %) and DG 2165 (5.6 %). Fewer plants of the AP 6101 (0.0 %) and AP4103 (5.0 %) varieties were defoliated than of the other entries included in the study.

The AP 6101 seed cotton yield (3078.9 kg/hectare) was greater than all other genotypes except AP 4103 (2754.8 kg/hectare) and DG 2108 (2582.8 kg/hectare), $P \leq 0.05$ (Table 3). The Stoneville 474 seed cotton yield (1402.9 kg/ha) was lower than all other entries in the study except DG 2108 (1813.9 kg/ha). Lint weight rankings of entries were identical to seed cotton yield rankings.

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A correlation exists between disease incidence and seed cotton yield (r = 0.8499: P < 0.01) (Figure 1). It is likely that the disease had an effect on yield, although genotypic traits may also contribute to yield differences.

Charcoal rot was not observed in AP 6101 under conditions of high temperatures and drought stress that caused other genotypes to succumb to the disease and it had one of the highest yields of all entries tested. There was a low disease incidence in AP 4103 and yields were similar to that of AP6101. DG 2383 was among the top three producing varieties although disease incidence was higher.

Charcoal rot is considered a minor problem on cotton; however, *M. phaseolina* is a common soil-borne fungus that can cause damage when cotton plants are stressed. Under conditions of high temperatures and drought stress, AP 6101 and AP 4103 may avoid heavy damage due to charcoal rot that could weaken and kill plants of Stoneville 474 and Texas 121 varieties and DG 2165, DG 2108, DG 2383, DG 2387 experimental breeding-lines, but further research is necessary to substantiate this.

References Cited

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Table 1. Association of sclerotia on roots with above ground charcoal rot symptoms.

Plant Health[w]	Percent roots with sclerotia
Dead	100.0 a[z]
Defoliated:Re-growth	32.6 b
No above-ground symptoms	0.7 c

[w]Above ground appearance of plants when sampled from 9-21 September.

[z] Means within the same column that are followed by the same letter do not differ significantly as determined by Student-Newman-Keul's Multiple Range Test, P = 0.05.

Table 2. Charcoal rot incidence on 30 August.

	Percent Plants[y]		
Variety	Affected	Dead	Defoliated
Stoneville 474	51.4 a[z]	4.0 bc	47.4 a
Texas 121	53.7 a	22.8 a	30.9 a
DG 2108	50.2 a	22.9 a	27.3 a
DG 2387	33.5 a	12.9 ab	20.6 a
DG 2383	33.0 a	12.9 ab	20.1 a
DG 2164	27.5 a	5.6 bc	21.9 a
AP 4103	6.8 b	1.8 bc	5.0 c
AP 6101	0.0 c	0.0 c	0.0 c

[y] On 30 August 1999 disease incidence was evaluated in 4 meters in each of two rows within each plot.

[z]Log transformed data was analyzed; non-transformed means are reported. Means within the same column that are followed by the same letter do not differ significantly as determined by Student-Newman-Keul's Multiple Range Test, P = 0.05.

Table 3. Kilograms per hectare seed cotton and lint.

Variety	Seed Cotton[y]	Lint[y]
AP 6101	3078.9 a	1200.0 a
AP 4103	2754.8 ab	1066.4 ab
DG 2383	2582.8 ab	1079.0 ab
DG 2165	2260.8 bc	902.9 bc
Texas 121	2245.5 bc	850.3 bc
DG 2387	2132.2 bc	878.1 bc
DG 2108	1813.9 cd	741.5 cd
Stoneville 474	1402.9 d	560.6 d

[y]On 5 October 1999, cotton was harvested a 4-meter sections, seed cotton weights were recorded, and cotton was ginned and lint weights were recorded.

[z]Means within the same column that are followed by the same letter do not differ significantly as determined by Student-Newman-Keul's Multiple Range Test, P = 0.05.

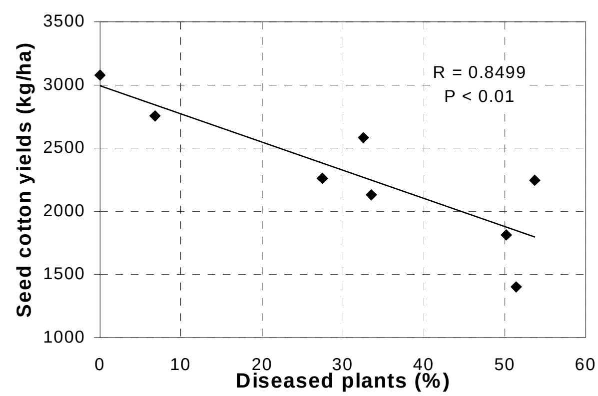

Figure 1. Yield and disease incidence of each entry included in the study.