

Natural Resistance of Cotton to Cotton Leaf Crumple Virus

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ABSTRACT

Cultivars and germplasm lines of cotton, Gossypium hirsutum L., differed in response to infection by the cotton leaf crumple virus (CLCV). The most widely grown cultivars in Arizona and southern California, 'Deltapine 90' and 'Deltapine 61', are susceptible, while 'Cedix', developed in El Salvador, and 'Conal', developed in Nicaragua, are highly resistant or immune. Nineteen other lines from a resistance breeding project in Nicaragua showed highly variable responses.

INTRODUCTION

Cotton leaf crumple virus (CLCV), transmitted by the sweet potato whitefly, Bemisia tabaci (Genn.), infects cotton, Gossypium spp. Disease symptoms include misshapen leaves and flowers, mosaicism, and stunting of growth that lead to yield losses. The CLCV disease is not usually considered very important because only a small percentage of plants are usually infected. However, it has the potential of becoming a serious disease because the whitefly is increasingly prevalent. Also, the currently grown cultivars in Arizona and southern California are susceptible. The objective of this report is to present the results of experiments carried out to screen domestic and exotic cultivars and germplasm lines of G. hirsutum for response to infection by CLCV.

MATERIALS AND METHODS

In 1986, 27 cultivars and germplasm lines were rated for reaction to natural infection of CLCV in the breeding nursery at the USDA-ARS Western Cotton Research Laboratory, Phoenix (WCRL). Plots were unreplicated; ca 20 plants of each cotton were rated. Ratings presented in this report were made at time of first boll opening (late July). Ratings are consensus ratings, i. e., Absent (A): no plants show symptoms; Mild (M): most or all plants show symptoms, but no plants show severe symptoms; Severe (S): all plants show obvious symptoms. Deltapine 61 was included as the susceptible control.

Eighteen cultivars and germplasm lines were also rated in unreplicated tests in the WCRL greenhouse and in the Department of Plant Pathology greenhouse at Tucson. Deltapine 61 was included as a susceptible control and Cedix was included as a putative resistant control. At WCRL, regrowth was rated on plants that had been cut back in the field and moved to the greenhouse. At Tucson, approximately 6 to 9 seedlings of each cotton at the two- to four-leaf stage, were exposed to viruliferous whiteflies that previously had been caged on infected cotton plants. These plants were allowed to grow for 30 to 60 days after exposure to whitefly, then rated for CLCV symptoms.

All Cedix plants that had been exposed to viruliferous whiteflies at Phoenix and Tucson and that were rated "A" were back-indexed at the two locations. That is, they were caged with uninfected whiteflies for 24 h, then transferred to plants of Deltapine 61 for 72 h. After sufficient time was allowed for symptom expression, the Deltapine 61 plants were rated.

Two replicated screening tests were carried out in the WCRL greenhouse at Phoenix and at the Department of Plant Pathology greenhouse at the University Campus Agricultural Center at Tucson. Test 1 included one seedling per replication of 16 cottons growing in 5-cm plastic pots. Experimental design was

a randomized complete block with 10 replications. At Phoenix, seedlings were caged with viruliferous whiteflies and CLCV infected cotton plants. After 48 hours exposure, seedlings were moved to a greenhouse bench. Because symptoms failed to appear, the plants were transplanted to 10-cm pots and fertilized heavily to encourage new growth. Symptoms still failed to appear, so 55 days after initial exposure, the plants were cut back and again exposed to viruliferous whiteflies. Plants were then transported to the Campus Agricultural Center greenhouse and rated for CLCV symptoms 39 days after the second exposure.

Test 2 included one seedling per replication of 17 cottons (including 11 that had been placed in Test 1) arranged in five randomized complete blocks. Seedlings were exposed to viruliferous whiteflies at Phoenix, transplanted to 10-cm pots, transported to Tucson, and rated 84 days after having been exposed. Of the 22 cottons that were rated in Tests 1 and 2, 19 came from a resistance breeding project in Nicaragua and one was from Israel. Deltapine 61 was included as a susceptible control and Cedix (FDW 946) was included as a resistant control.

Each plant was rated separately (A=1, M=3, and S=5). Ratings were transformed (square root of X). Because some plants had died before rating, transformed data were analyzed by a one-way (among and within cottons) analysis of variance. Mean ratings for the test cottons were compared with those of Deltapine 61 with the use of the LSD test.

RESULTS AND DISCUSSION

The two most widely grown cultivars in Arizona and southern California, Deltapine 61 and Deltapine 90, were rated "S" uniformly (Table 1). In fact, all Deltapine cultivars were rated "S" or "M" except for 'Deltapine 62', which had some plants that were rated "A". The Stoneville cultivars and germplasm lines were rated "A" or "M". This result suggests that the Stoneville germplasm is less susceptible to CLCV than is the Deltapine germplasm. The DES germplasm lines varied from uniformly severely affected (DES 237-7) to variably affected. All Cedix (FDW 946) plants were rated "A". The Deltapine 61 plants that were back-indexed with whiteflies that had been placed on the Cedix plants failed to show CLCV symptoms.

The Nicaraguan germplasm lines varied widely in CLCV ratings (Table 2). In Test 1, only NIC 71-23 and Cedix had significantly lower ratings than did Deltapine 61. In that test, one of nine NIC 71-23 plants and three of nine Cedix plants were rated "M". This result suggested that Cedix either is not uniformly resistant to CLCV or that some seed contamination has occurred. Also in Test 1, Deltapine 61 showed a variable response; one of eight plants was rated "A" and five were rated "M". In Test 2, 11 of 14 Nicaraguan lines, Cedix, and BD-12 from Israel had significantly lower ratings than did Deltapine 61. The resistant Nicaraguan lines included NIC 71-23, plus five others that had not differed significantly from Deltapine 61 in Test 1. All four Cedix plants were rated "A"; two Deltapine 61 plants were rated "M"; and three were rated "S".

Cedix has been crossed to a number of cultivars and breeding stocks with the objectives of transferring resistance and studying the inheritance of resistance. Cedix and four NIC lines (NIC 71-23, NIC 71-1655, NIC 71-1728, and NIC 71-1870) are being increased for future field experiments.

The 'Conal' cultivar, received in 1987 from Nicaragua, showed no CLCV symptoms in the 1987 field nursery, or in the 1987-1988 greenhouse planting at Phoenix. This cultivar lacks extrafloral nectaries, a pink-bollworm resistance trait, which enhances its potential usefulness in our breeding program.

Nothing is known about the response of Cedix, Conal, or the NIC germplasm lines to sweetpotato whitefly. On the other hand, BD-12, which carries the semi-smoothleaf, okra leaf, and frego bract traits, apparently is significantly less susceptible than other cultivars with which it has been compared.

In general, smoothleaf cottons harbor lower populations of whitefly than do hirsute ones. Also, there is some indication that the more open canopy of okra-leaf cottons discourages large whitefly populations. It therefore seems worthwhile to incorporate CLCV resistance into cottons that possess these traits. It also seems worthwhile to search for other sources of whitefly resistance because a very high level of CLCV resistance, combined with adequate whitefly resistance, could solve the whitefly/virus problem.

Table 1. Field and greenhouse ratings for cotton leaf crumple disease of cultivars and germplasm lines, Phoenix, AZ, 1986.

Cultivar or germplasm line	CLC rating		
	Absent	Mild	Severe
Deltapine 61			X
Deltapine 90			X
Deltapine 120			X
Deltapine 775			X
DES 237-7			X
Deltapine 7544N*		X	X
Deltapine 7544NL		X	X
DES 56NL		X	X
DES 56N		X	X
Deltapine 712		X	
DES 24NSSL		X	
DES 119-13		X	
Stoneville 213		X	
Stoneville 213L		X	
Stoneville 506		X	
Stoneville 8737NL		X	
Deltapine 62	X	X	X
DES 56N	X	X	X
Deltapine 733	X	X	
Stoneville 825N	X	X	
Stoneville 8701N	X	X	
Stoneville 8737N	X	X	
Cedix (FDW 1021)	X	X	
Stoneville 7A	X		
Stoneville 7A-L	X		
Stoneville 8701NL	X		
Cedix (FDW 946)	X		

*N=nectariless, L=okra leaf, SS=semi-smoothleaf