

Cotton Leaf Crumple Virus, A Whitefly-Transmitted Geminivirus Of Cotton In Arizona

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Summary

Cotton leaf crumple, a disease which has recently (1981-1984) become more important in southwestern cotton as population levels of the whitefly vector, Bemisia tabaci Genn., have increased, may result in losses of 20-80%. The disease agent was recently shown to be an unusual type of plant virus, known as a geminivirus. Plant species within the Convolvulaceae, Leguminosae, and Malvaceae are now recognized as virus hosts, in addition to Gossypium species which were previously the only known hosts of the disease agent. Endemic weeds as well as cultivated cotton, therefore, may serve as important virus sources in the southwestern U.S.

The cotton leaf crumple (CLC) disease which incites severe floral and foliar hypertrophies of cotton (Gossypium hirsutum L.) was described in California in 1954 (Dickson et al) and in Arizona in 1960 (Allen et al). The CLC disease is transmitted exclusively by Bemisia tabaci Genn., the sweet potato whitefly, and not by seed or mechanical means (Laird and Dickson, 1959). Significant yield losses are associated with the disease (Allen 1960, Russell 1982, van Schaik et al 1962) and range from 21 to 71 percent. CLC has occurred sporadically in the southwest since 1954 and epidemics appear to be dependent both upon the early buildup of vector populations and the age of the host plant at inoculation time (Brown, Butler and Nelson, 1983). In years when mild winter temperatures facilitate the local overwintering of B. tabaci on perennial weeds (Butler, Henneberry, and Natwick, 1984) an early season vector reservoir may become established and disease may be severe (Butler and Brown, 1984, unpublished). The host range of the CLC agent is not confined to Gossypium sp. as previously thought. Newly identified hosts include legumes (Phaseolus sp. and Vigna sp.), convolvulaceous plants (wild morninglory and field bindweed) and other malvaceous hosts (Althaea sp., Hibiscus sp.) (Brown and Nelson, 1984). Both wild and cultivated plants within these genera are commonly found in cotton growing regions and therefore are potential overseasoning or alternate reservoirs of the CLC disease agent.

The discovery of bean as a CLC host made the isolation of the disease agent more feasible since attempts to purify a virus-like agent from cotton tissue (which contains viral-inactivating phenolics and polysaccharides) failed repeatedly over a two year period. Recently, virus-like particles were isolated from CLC-inoculated bean plants (Brown and Nelson, 1984) and were demonstrated to be the causal agent of CLC (Brown, unpublished). The CLC virus (CLCV) resembles, and therefore is tentatively assigned to the newly established geminivirus group, the first group of single-stranded dna plant viruses.

The impact of CLCV on cotton yields in Arizona has been implicated by yield loss evaluations (Allen 1960, Russell 1982) but definitive epidemiological and varietal studies may be required to appreciate large-scale losses in Arizona cotton.

In the greenhouse, cotton plants inoculated in the cotyledon stage exhibit dramatic symptoms. Symptoms are progressively less noticeable as the age of the plant at inoculation time increases and are relatively impossible to detect if cotton is inoculated at flowering to boll set stages (Brown, Butler, and Nelson, 1983). Preliminary field observations indicate that if apparently symptomless (but infected) cotton is stubbed or damaged by field machinery, the flush regrowth exhibits typical CLC symptoms.

The possibility exists, therefore, that more losses occur following both detectable (early-infection) and undetectable (mid to late season infection) CLCV infections than previously supposed. Further analysis of the field situation is required to substantiate these hypotheses.

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