Tomato Spotted Wilt Virus Epidemic in Flue-Cured Tobacco in Georgia

A. K. CULBREATH, Assistant Professor, and A. S. CSINOS, Professor, Department of Plant Pathology, University of Georgia College of Agriculture, Coastal Plain Experiment Station, Tifton 31793-0748; P. F. BERTRAND, Professor, University of Georgia, Cooperative Extension Service, Tifton 31793-1209; and J. W. DEMSKI, Professor, Department of Plant Pathology, University of Georgia, Georgia Experiment Station, Experiment 30212

ABSTRACT

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Spotted wilt, caused by tomato spotted wilt virus (TSWV), was first diagnosed in flue-cured tobacco (*Nicotiana tabacum*) in Georgia in 1986. By 1988, tobacco fields in 28 of 48 tobacco-producing counties had plants infected with TSWV, but the incidence was less than 1%. In 1989, spotted wilt was observed in all tobacco-growing counties in Georgia. Average incidence was low with 5–7% of plants examined showing symptoms. However, in some fields, incidence was more than 20% and losses in plant stand were observed. First symptoms appeared shortly after tobacco seedlings were transplanted to the field in March, and numbers of symptomatic plants increased through initiation of harvest in June.

Tomato spotted wilt virus (TSWV) causes serious problems in tobacco (*Nicotiana tabacum* L.) in many areas of the world (6). Spotted wilt epidemics in tobacco in the United States have been limited to Perique tobacco in Louisiana (6), although TSWV has caused significant losses in other field and ornamental crops. Spotted wilt was first confirmed in flue-cured tobacco in Georgia in 1986, when a few infected plants were detected in two tobacco fields (1). Surveys in 1987 and 1988 indicated that incidence of spotted wilt was increasing in tobacco but not at levels high enough to cause significant losses of plant stand or yield (3).

MATERIALS AND METHODS

During the 1988 and 1989 growing seasons, fields in each of 48 tobacco-producing counties in Georgia were checked for incidence of tomato spotted wilt. These represented both fields chosen at random and locations in which a problem was identified. Diagnoses were made on the basis of symptomatology and serological tests. Symptoms were distinct from those caused by other pathogens present. Confirmation of the presence of the virus with ELISA was obtained for random samples diagnosed on the basis of symptoms. Samples taken for confirmation consisted of entire symptomatic leaves. These were refrigerated until portions of the leaves were ground for ELISA preparation. Antiserum used for virus detection had been prepared by Sreenivasulu et al (10) from an isolate of TSWV originally from peanut. Incidence was estimated by counting the number of symptomatic plants in 15.3 or 30.5 m of row in three or four randomly chosen locations in the field.

Incidence of spotted wilt, based on apparent symptoms, was monitored over time in one grower's field in each of Ware, Brooks, and Tift counties and in one field on the Coastal Plain Experiment Station, Tifton, GA. The Ware County plot was six rows wide and 46.2 m long. At the Brooks County location, two plots (eight rows wide and 46.2 m long) were established in each of three areas representing planting dates of 6 March, 13 March, and 26 March. Five plots (four rows wide and 46.2 m long) were established at the Tift County location. Cultivars used were NC79, Speight G-28, and K-326 for the Ware County, Brooks County, and Tift County locations, respectively. The experiment station site was planted in small plots of 43 different tobacco cultivars and breeder lines. Seed beds from which these plants originated were also monitored during the season. Biweekly counts of the number of symptomatic plants in each location were made. Final cumulative incidence was calculated as the percentage of the total original plant stand that developed symptoms of the virus.

RESULTS AND DISCUSSION

Spotted wilt occurrence was widespread across the tobacco-growing region of Georgia in 1988; it was detected in 28 of 48 tobacco-producing counties (Fig. 1). In 10 counties, plants with spotted wilt were observed in more than 80% of the fields examined. Incidence in

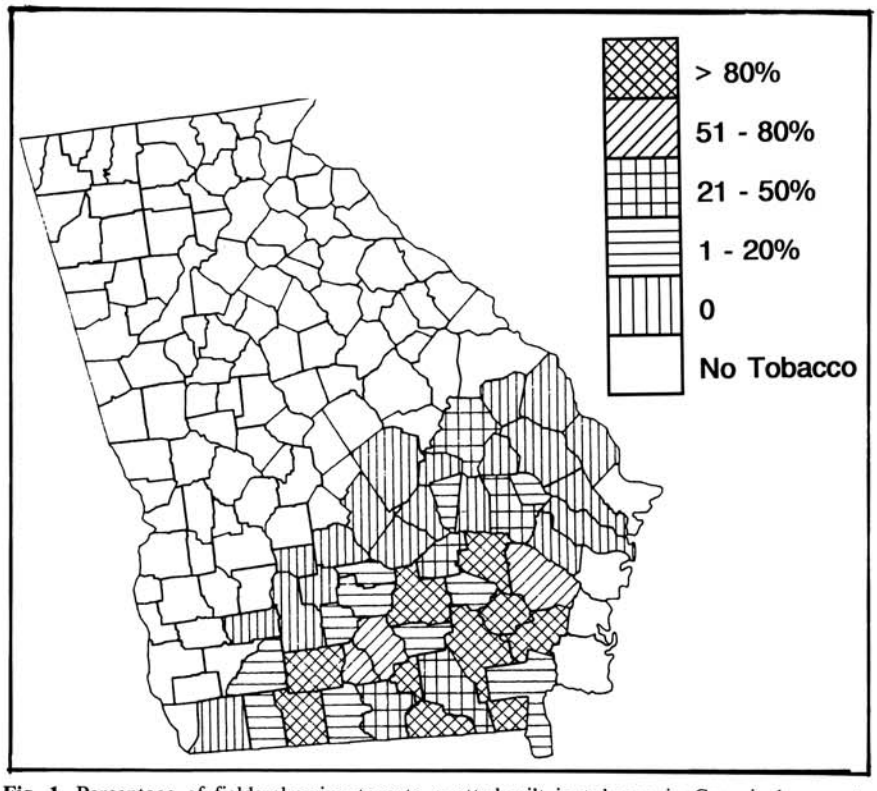

Fig. 1. Percentage of fields showing tomato spotted wilt in tobacco in Georgia by county, 1988.

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infested fields was generally less than 1%. The incidence of spotted wilt increased further in tobacco in Georgia in the spring of 1989. Occurrence of the disease was noted in every tobacco-producing county and almost every field in the state. Spotted wilt was diagnosed in all of the predominant flue-cured tobacco cultivars grown in Georgia. Based on the range of incidence observed in each of the different cultivars, no difference in susceptibility to the virus was apparent among them. Direct comparisons of the different cultivars are being made in current experiments but are not complete.

As typically reported (6), symptoms varied with the age of the infected plant (Fig. 2). Foliar symptoms included small concentric necrotic rings and chlorotic spots that often coalesced (Fig. 2). Veinal necrosis was observed on most symptomatic leaves. Severe distortion and necrosis of levels in the terminal bud were observed in symptomatic young plants. First symptoms generally were observed in the spiral bud. Elongated concentric darkened spots and lesions were observed on the main stalks above and below symptomatic leaves in the older plants. Concentric ring spots and dark necrotic spots were observed in the flowers of some plants where inflorescentia were not removed. Death of the entire plant soon followed appearance of symptoms in many plants. Plants that died early in the growing season often were badly decomposed and completely overgrown by adjacent plants before the crop matured. Therefore, underestimation of disease incidence may have resulted in cases where single point assessments were used.

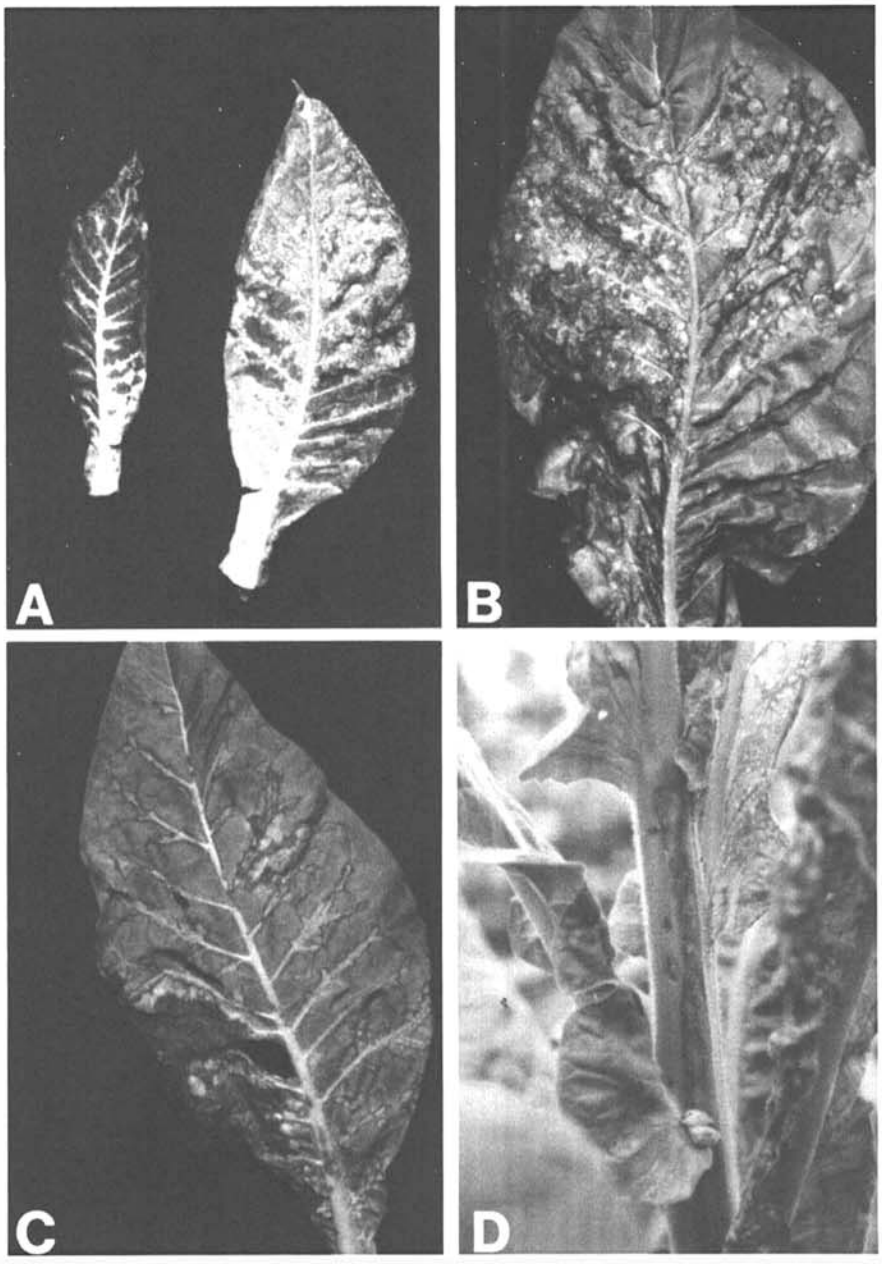

Fig. 2. Tobacco leaves showing **(A)** stunted and distorted young tissues, **(B)** coalesced lesions and necrotic areas, **(C)** veinal chlorosis and necrosis in older leaves, and **(D)** lesions on main stem of tobacco plant.

Average incidence in tobacco fields across the state was estimated to be 5–7% of the total population, although incidence of more than 20% was observed in specific fields. Losses in yield to spotted wilt occurred in some fields, but estimates of the impact on total tobacco yield in Georgia are very difficult to calculate and are not yet available.

At the Ware, Brooks, and Tift locations, appearance of symptomatic plants began shortly after plants were transplanted in the field and continued through initial harvests. Based on preliminary characterization of the epidemics, initial infections and appearance of symptomatic plants throughout the growing season occurred in random patterns in all fields. Incidence gradients from field borders typically were not observed. Increase in incidence slowed after plants were topped. Cumulative TSWV incidence in the four field locations ranged from 3.5 to 22.5%. It was highest in the Ware County plot (22.5%). In Brooks County, incidence was 8.3, 11.8, and 11.7% at the 6 March, 13 March, and 26 March planting dates, respectively. Cumulative incidence was lowest at the Tift County grower's farm (3.6%) and the Coastal Plains Experiment Station (8%).

Symptomatic plants were rarely observed in the seed beds and usually occurred at a very low incidence, even in beds where plants remained until late in the season. This would provide circumstantial evidence suggesting infections were not initiated in the seed beds in most cases but originated after transplanting from inoculum sources near fields. This is speculative, however, in that infections may have gone undetected.

Mild winter temperatures during 1988–1989 (Fig. 3) may have allowed survival of greater than normal numbers of weed hosts of the virus, providing high levels of inoculum. Weeds may also serve as host for tobacco thrips (*Frankliniella fusca* (Hind)) and western flower thrips (*Frankliniella occidentalis* (Pergande)), which occur on tobacco in Georgia (7) and serve as vector of the virus (8,9). These are capable of surviving on many of the numerous weed hosts that have been reported (2,4,5). The survival of weed hosts may have allowed development of a greater number of viruliferous thrips for the 1989 tobacco growing season than would have been encountered in a year with a colder winter.

Increases in the range of occurrence and incidence of spotted wilt in tobacco in the past few years represent a potentially severe new disease problem in tobacco production in the the southeastern U.S. The extent to which the virus will eventually occur in other tobacco-growing areas remains unknown.

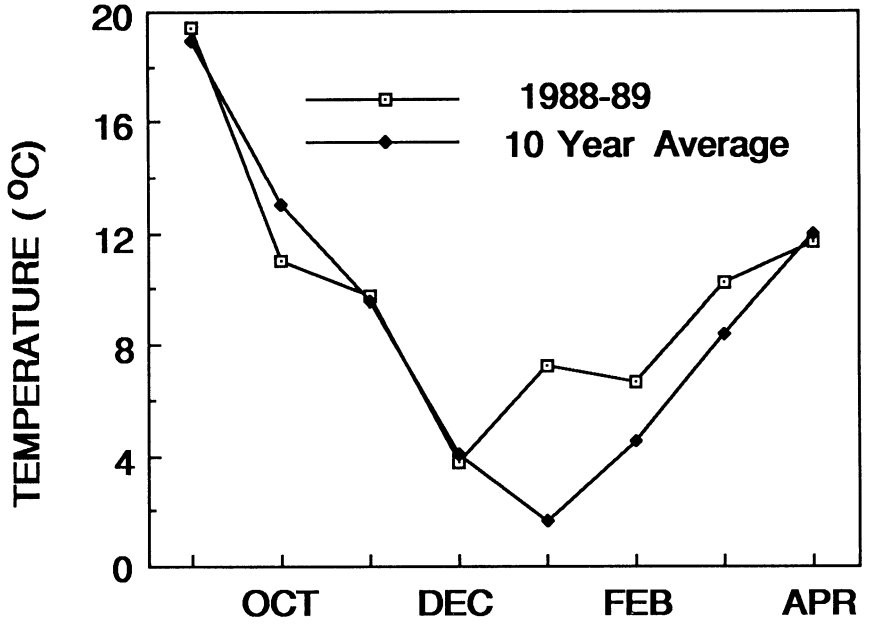

Fig. 3. Monthly average of daily low temperatures for the winter of 1988–1989 and the 10-yr average.

In addition to tobacco, the host range of the virus includes several species of crop plants of great economic importance to the region. Occurrence and increase in incidence of spotted wilt in peanut (*Arachis hypogaea* L.), tomato (*Lycopersicon esculentum* Mill.), and pepper (*Capsicum annuum* L.) also has been observed in Georgia. The combination of the wide host range of the virus, the severe effects that the virus has on many of the crop plants included in that range (4), and the importance of those crops to the economy of the Southeast indicates that TSWV has the potential to be one of the most important and destructive single plant pathogens present in the region if this new epidemic continues to develop.

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