New hope for Verticillium control in cotton

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The pessimistic view on control of Verticillium wilt of cotton, which we presented a few years ago (*California Agriculture,* November 1975), has for good reason changed to one of optimism. Tests at West Side Field Station have established the quantitative influence of inoculum (number of soilborne microsclerotia) of the wilt fungus (*Verticillium dahliae* Kleb.) on yields of cotton varieties with differing tolerances to wilt, and these results are applicable to commercial fields. Development of an accurate procedure for determining the number of microsclerotia per gram (MS/g) (inoculum density of soil), made these studies possible. Data also were developed on the range and average levels of inoculum in San Joaquin Valley soils and on how cropping practices affect inoculum levels in soil.

Growers will be able to make objective decisions to keep inoculum within tolerable levels by adjusting cropping practices. Also, it will be possible to take advantage of the natural attrition of the fungus survival structures (microsclerotia), which occurs in absence of crops that favor increase of new inoculum. The key to success is to monitor inoculum levels of the fungus through soil assays. Verticillium assay service to growers now is available from several commercial laboratories.

Yield loss from Verticillium wilt of cotton is associated with premature defoliation; an earlier, but less obvious, factor is square and young boll shedding by infected plants. Premature defoliation is influenced by the amount of the fungus inoculum in soil, the relative susceptibility of the cotton variety, and the occurrence of weather favoring development of severe disease. Yield of variety Acala SJ-2 was reduced a maximum of 20 to 25 percent in 1974 and 1976 in fields where inoculum densities were 21 to 23 MS/g soil. Weather conditions did not favor severe disease development in 1975, and yields were not significantly reduced that year, regardless of inoculum density (fig. 1). Results from these experiments show that, although there is always a correlation between inoculum density and percentages of infected and of defoliated plants, efficiency of inoculum varies from year to year because of weather conditions.

We compared disease development and yields of a very susceptible breeding line of

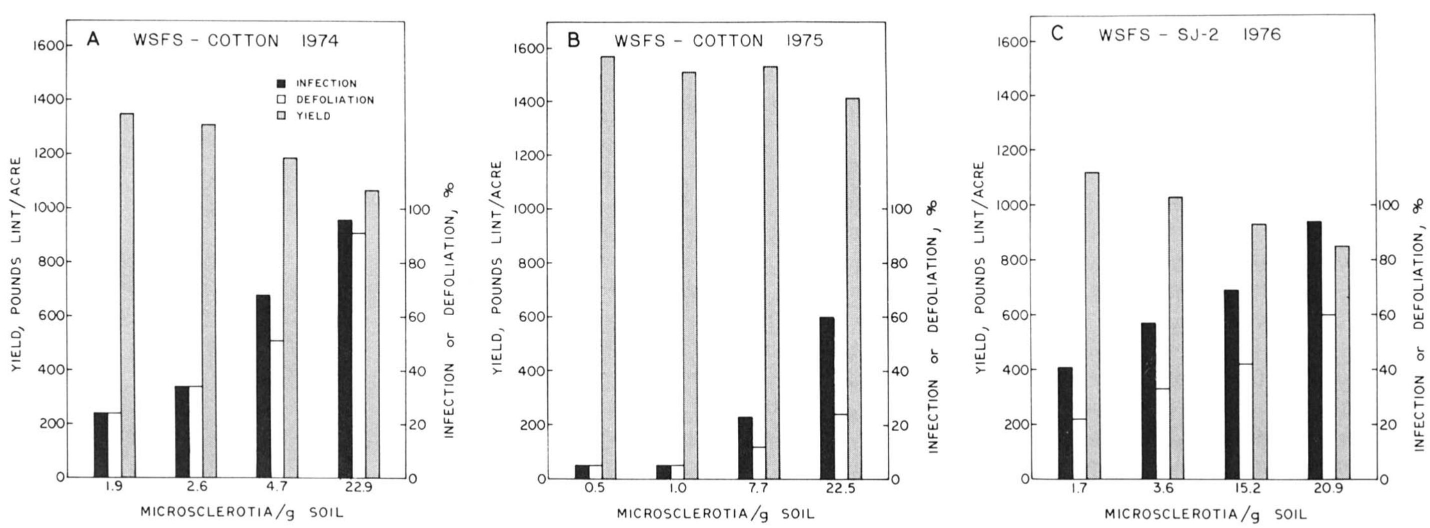

Fig. 1. Influence of Verticillium inoculum density on Acala SJ-2 cotton at West Side Field Station during three years.

TABLE 1. Relationship between Microsclerotial Inoculum Density of *Verticillium dahliae* and Yields of Four Cotton Varieties, West Side Field Station, 1976

Cotton varieties	Lint yields at four inoculum densities*				
	1.7	3.6	15.2	20.9	L.S.D., 0.05
	lb/a	*lb/a*	*lb/a*	*lb/a*	
70-110	1,088	935	818	686	73
Acala SJ-2	1,115	1,034	919	855	64
Acala SJ-4	1,146	1,102	977	1,064	N.S.
Acala SJ-5	1,014	1,000	980	1,037	N.S.
L.S.D., 0.05	146†				

*Inoculum density — number of microsclerotia per gram of soil.
†Differences greater than 146 pounds of lint are significant at 95 to 5 odds.

TABLE 2. Influence of Cropping Practices on Inoculum Densities of *Verticillium dahliae* in Eight San Joaquin Valley Fields

Field	I.D.* 1979	Cropping practices during 1974-1978				
		1978	1977	1976	1975	1974
1	30.6	cotton	cotton	cotton	cotton	cotton
2	25.2	potato	cotton	cotton	cotton	cotton
3	25.2	cotton	cotton	cotton	grain†	cotton
4	12.7	cotton	cotton	grain	cotton	cotton
5	4.9	melon	melon‡	cotton	cotton	cotton
6	4.5	cotton	fallow	cotton	cotton	cotton
7	5.1	cotton	onion	potato	cotton	cotton
8	0.7	cotton	fallow	grain	cotton	cotton

*Inoculum density—number of microsclerotia per gram air-dry soil.
†Barley or wheat.
‡Honey dew melon.

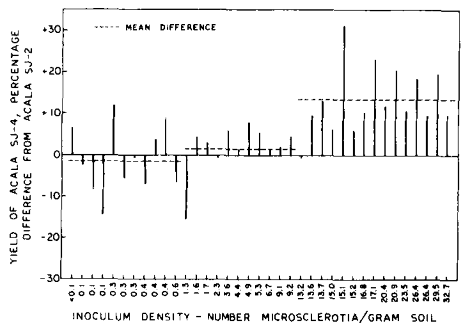

Fig. 2. Comparative yields of Acala SJ-2 and SJ-4 cotton in 37 commercial plantings as affected by natural infestations of wilt fungus microsclerotia.

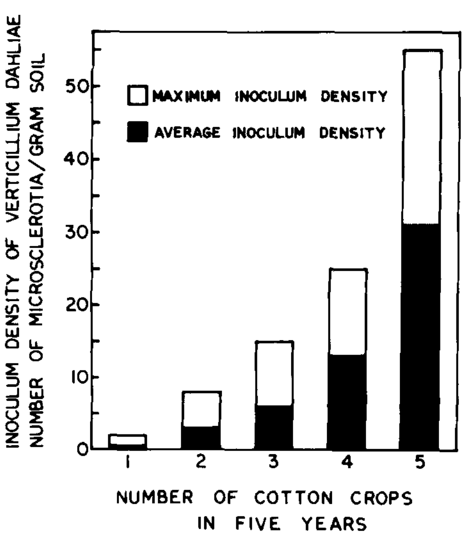

Fig.3. Influence of cotton cropping on buildup of wilt fungus inoculum in soil.

cotton, called 70-110, with moderately tolerant Acala SJ-2 and with even more tolerant varieties Acala SJ-4 and SJ-5 in soil with different inoculum levels. In 1976, yields of 70-110 and Acala SJ-2 decreased with each increase in inoculum density between 1.7 and 20.9 MS/g soil, but yields of the more tolerant varieties, Acala SJ-4 and SJ-5, were unaffected even at the greatest inoculum density (table 1). The variety 70-110 yielded as well as the others at 1.7 and 3.6 MS/g soil but only as well as Acala SJ-2 at 15.2 MS/g soil.

Although Acala SJ-2 yielded as well as Acala SJ-4 at 15.2 MS/g soil in this test, results of 37 comparisons made of the two varieties in commercial fields showed that SJ-4 out-yielded SJ-2 by an average of 13 percent at inoculum densities greater than 9 to 13 MS/g soil. On the other hand, yield of Acala SJ-4 was only about 3 percent greater at inoculum densities below 9 to 13 MS/g soil (fig. 2). Because Acala SJ-4 and Acala SJ-5 are, respectively, fourth and fifth generation descendents of the same parents, the differences between SJ-2 and SJ-4 should be applicable to SJ-2 and SJ-5, which completely replaced SJ-4 as the wilt-tolerant variety in 1979.

The overall average amount of inoculum in San Joaquin Valley cotton soils appears to be relatively stable. For instance, the average inoculum density of 40 fields assayed in 1971 was 7.4 MS/g soil; the maximum inoculum density was 47 MS/g soil, but about 75 percent of fields had fewer than 6 MS/g soil. Similar results were obtained in assays of 120 fields in 1977; the average inoculum density was 5.3 MS/g soil, and about 75 percent of fields had fewer than 6 MS/g soil. These observations probably explain why Acala SJ-2, only moderately tolerant of Verticillium wilt, occupies about 80 percent of San Joaquin Valley acreage: it commonly outyields more tolerant varieties in mild wilt situations.

The importance of cotton in increasing inoculum levels was shown when inoculum densities of 52 fields in 1979 were related to the number of cotton crops grown in the previous five years. The average amount of inoculum approximately doubled with each cotton crop grown in addition to one in five years (fig. 3). Thus, monoculture or near monoculture cropping of cotton (fields 1 to 4, table 2), resulted in unacceptably high levels of inoculum except for highly tolerant cotton varieties.

Cotton culture results in the greatest increase of new inoculum, because microsclerotia form only in moist, dead, infected tissue during cool weather. On the other hand, inoculum buildup is not favored in tissue of susceptible crops such as potato, tomato, melons, and safflower harvested in hot weather. In the San Joaquin Valley, decrease of inoculum when these crops are grown is similar to that when fields are fallowed. Therefore, the rotations for fields 5 to 8 in table 2 kept inoculum levels low enough so that a cotton variety such as Acala SJ-2 could be grown successfully.

None of these rotations can be considered as consistent recipes for success, however, because inoculum buildup following a cotton crop varies from field to field and year to year. Major differences may occur between average and maximum inoculum densities (fig. 3). Therefore, inoculum levels in each field must be determined.

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Combination recommended

Don A. Edwards

Leaf curl was related to vigorous shoot growth rather than rootstock and did not affect yield or fruit characteristics.