INTEGRATED CONTROL OF VERTICILLIUM WILT OF COTTON BY SOIL SOLARIZATION
AND TOLERANT CULTIVARS

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INTRODUCTION

About 70,000–90,000 ha of cotton (Gossypium hirsutum L.) are grown annually in Spain. Almost half of that acreage occurs in the Lower Guadalquivir Valley (Marismas) where cotton is grown intensively in clay, fertile soil mainly in 1 year rotation with cereals.

Verticillium wilt, induced by Verticillium dahliae Kleb., affects severely cotton crops in Marismas because of the occurrence of high inoculum densities of a defoliating pathotype of the pathogen which has become widespread in the area during the last decade. Economical reasons make suitable the practice of long crop rotations with nonhosts. Thus, eradicative control measures and the use of tolerant cultivars are needed for control of the disease. This paper presents results of research to determine the effectiveness of soil solarization, alone and in combination with the use of tolerant cultivars, for control of Verticillium wilt of cotton in the Marismas area of southern Spain.

VERTICILLIUM WILT CONTROL BY SOIL SOLARIZATION

Five field experiments were conducted in 1986-1988 to determine the effectiveness of soil solarization in eradicating V. dahliae from naturally infested soils and the subsequent effects on Verticillium wilt incidence and yield of cotton (Jiménez-Díaz et al., 1990). Two fields (A,B) with high and low inoculum density, respectively, were used in 1986-1987. Solarized and unsolarized plots were replicated six times in a randomized complete block design. Plots (35-60 m²) were irrigated and then tarped with transparent polyethylene sheets (25-37 μm thick) from mid July to the end of August in 1986. Larger plots (100-200 m²) were used in each of three additional experiments (fields C,D,E) conducted in 1987-1988. Solarization treatment
was replicated twice in completely randomized blocks. Soil tarping was removed at the end of September 1987 because the summer had been cloudy and rainy and with mild temperature (maximum and minimum daily air temperatures ranging 20-42°C and 14-21°C, respectively).

Assessment of *V. dahliae* in the upper 20 cm-layer of soils by the Andersen sampler technique (Butterfield and DeVay, 1977) at the end of the solarization periods indicated that the pathogen was completely eradicated from soil in solarized plots. In these plots, inoculum density of *V. dahliae* continued to be at very low levels up to the planting time (6-7 months after solarization), whereas it increased significantly in unsolarized plots during the same period. Solarized and unsolarized plots were sown to Verticillium wilt-susceptible cotton cv Coker 310 in March-April 1987 (A,B) and 1988 (C,D), and incidence of the disease was determined by the percentage of plants showing foliar symptoms at the end of July and early September. In fields with a high inoculum density (A,C), the final disease incidence in solarized plots was much lower (5.0 and 13.5%, respectively) as compared to that in unsolarized control plots (90.5 and 87.7%, respectively). In fields with lower inoculum density (B,D), the final disease incidence was moderate (60.1 and 55%) in unsolarized plots and very low (4.5 and 1.8%) in solarized ones.

The effect of disease on yield was more pronounced in the 1987 crops, for which mild summer temperatures occurred that favored the development of severe disease. In this year, seedcotton yield in solarized plots was increased by 131% of that in unsolarized controls in field B which had a low inoculum density. High temperatures prevailed during the summer of 1988, which apparently determined seedcotton yield increases in solarized plots of 110% for field C with high inoculum density and of 34% for field D with low inoculum density.

**USE OF SOIL SOLARIZATION IN COMBINATION WITH TOLERANT CULTIVARS FOR CONTROL OF VERTICILLIUM WILT (VW) OF COTTON**

In 1988, two additional fields (F,G) with high inoculum density were selected for studies on integrated control of VW by means of soil solarization and tolerant cotton cultivars. Solarization was performed from mid July to mid September 1988. Experimental plots (600 and 500 m² for fields F and G, respectively) were replicated four or three times in a randomized complete block design. Plots were divided into halves and planted to either Coker 310 (susceptible) or Acala SJ-2 (moderately tolerant) cultivars in March 1989. Stand was 88,000 and 156,000 plants/ha for fields F and G, respectively. In 1990, plots F and G were planted to the highly tolerant "Acala GC-510" with a stand of 157,000 and 215,000 plants/ha, respectively. Assessment of inoculum density in the plots was conducted just before and immediately after solarization in 1988. Further assessments of inoculum density were made about 1 month after planting, in April 1989 and 1990. Results are shown in Fig. 1. Complete eradication of *V. dahliae* was achieved in the upper 20-cm soil layer of solarized plots. However, some seasonal increase in inoculum density was observed in unsolarized plots during the summer of 1988. By April 1989, trace levels of the pathogen were detected in solarized plots whereas there were decreased levels of inoculum density in unsolarized ones. Nevertheless, after one cotton crop in 1990, inoculum density of *V. dahliae* in soils from unsolarized plots had increased to levels higher than those occurring in September 1988, regardless of cultivars used (Fig. 1). Moreover, inoculum density in solarized plots also increased after one cotton crop to a level of about 10 propagules/g regardless of cultivar planted.

The effectiveness of soil solarization and tolerance of cultivars for control of the disease was assessed by the incidence of foliar symptoms,