

### Effect of Alanine on Development of *Verticillium* Wilt in Cotton Cultivars with Different Levels of Resistance

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#### ABSTRACT

Alanine injected in the xylem increased both the severity of *Verticillium* wilt symptoms and the rate of disease development in the young fast-growing plants of susceptible (Stoneville 62) and tolerant (Oklahoma 141-5) cotton cultivars. However, resistant Seabrook plants showed no change in resistance after alanine uptake. *Phytopathology* 61: 881-882.

*Additional key word: Gossypium.*

Amino acid contents of plants have been related to their susceptibility and resistance to disease in several studies (3, 4, 5, 6). Increased levels of histidine or lysine or both in blueberry fruits coincided with their increased susceptibility to *Glomerella cingulata* (Ston.) Spaulding & Schrenk (6). Application of D and DL isomers of phenylalanine markedly increased the resistance of several apple varieties to scab (4). Cotton varieties resistant to *Fusarium* wilt contained considerably more cystine in their roots than did susceptible ones (5). Booth (1) reported that the root

exudates from susceptible lines of cotton contained more alanine than did a *Verticillium* wilt-tolerant line. Recently, Guinn & Brinkerhoff (2) suggested that increased levels of amino acids (particularly alanine) in the xylem sap and roots of cotton, caused by oxygen deficiency, may affect development of *Verticillium* wilt.

This study was undertaken to determine the effect of alanine on the development of *Verticillium* wilt in susceptible (*Gossypium hirsutum* L. 'Stoneville 62'), tolerant (*G. hirsutum* 'Oklahoma 141-5') and resistant (*G. barbadense* L. 'Seabrook') cottons. Cotton plants took up 25 ml of an  $\alpha$ -DL-alanine (2 g/liter) solution with and without conidia ( $10^5$ /ml) of *Verticillium albo-atrum* Reinke & Berth. from waxed paper cones sealed about the base of the stems. The liquid entered the xylem through a diagonal cut in the stem made after the cones were filled. Water and water plus conidia served as controls. Three tests were made, one with slow-growing 133-day-old plants, grown individually in 6-inch pots in a greenhouse; one with fast-growing 50-day-old greenhouse plants; and one in the field in September. The greenhouse plants were tested in growth chambers at low (27 to 28-C day and 20-C night) and high (37 to 39-C day and 31-C night) temperatures.

The rate of uptake of liquid depended upon the cultivar and the presence or absence of conidia. Addition of conidia to the alanine solution and to the water check slowed uptake, and the effect was most pronounced in the resistant Seabrook.

The application of alanine affected both the rate of development and severity of *Verticillium* wilt. Disease symptoms developed in the susceptible cultivar 4-5 days earlier when alanine was supplied with the conidia than when alanine was omitted. Wilt symptoms were more severe in young plants (of both susceptible and tolerant cultivars) treated with alanine and conidia than in those treated with water and conidia. However, there was no apparent effect of alanine on the resistant Seabrook (Table 1).

Alanine, with or without conidia, caused interveinal

TABLE 1. Severity of *Verticillium* wilt after 15 days' inoculation in plants of cotton cultivars with different levels of resistance<sup>a</sup>

Treatment	Temperature	Cultivar					
		Susceptible Stoneville 62		Tolerant Oklahoma 141-5		Resistant Seabrook	
		133-day-old	50-day-old	133-day-old	50-day-old	133-day-old	50-day-old
Water	High		0		0		0
Water	Low	0	0	0	0	0	0
Water	High		0		0		0
+ Alanine	Low	Interveinal necrosis (after 4 days)	Necrosis chlorosis (after 3 days)	0	Chlorosis (after 4 days)	0	0
Water	Low	+++	+++	++	++	+	0
+ Conidia	Low						
Water + Alanine + Conidia	Low	+++	++++	++	+++	0	0

<sup>a</sup> Grading refers to the majority of plants in a treatment: 0 = no symptoms; + = epinasty and incipient wilt; ++ = leaf scorching and wilt; +++ = severe wilt and partial defoliation; ++++ = severe wilt and complete defoliation.

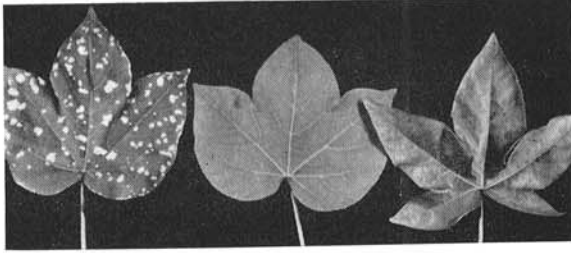


Fig. 1. Leaves from cotton plants treated with alanine. (Left) Interveinal necrosis characteristic of *Verticillium* wilt-susceptible Stoneville 62. (Center) Mild chlorosis characteristic of wilt-tolerant Oklahoma 141-5. (Right) No symptoms characteristic of wilt-resistant Seabrook Sea Island.

necrosis in leaves 2-4 days after uptake by Stoneville 62 plants at temperatures favoring disease development (Fig. 1). Some chlorosis was also noticeable in the leaves of similarly treated plants of Oklahoma 141-5, but not in the *Verticillium* wilt-resistant Seabrook. Phytotoxicity from alanine did not develop at temperatures unfavorable for wilt (above 30 C). Alanine alone

caused relatively mild vascular browning in cotton stems in the growth chamber. In the field, the vascular browning was more pronounced, especially in Seabrook; it resembled the discoloration caused by *Verticillium albo-atrum*.

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