

Effect of mixed inoculations with *Fusarium oxysporum* f. sp. *lycopersici* and *F. oxysporum* f. sp. *dianthi* on the phenols content of tomato plants

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Abstract

Forms of *Fusarium oxysporum* specific on hosts other than tomato induce in this plant greater initial increases of the phenols content than the pathogenic f. sp. *lycopersici*. Mixed inoculations of f. sp. *lycopersici* and f. sp. *dianthi* are on the contrary no more effective in inducing the phenol accumulation 24 h after the infection than f. sp. *lycopersici* alone. This observation suggests that the pathogen can suppress the phenolic response that is typical of the incompatible combinations.

The effect of *Fusarium* infections on the phenols content of resistant and susceptible tomato plants has been investigated by different authors with contradictory results (Davis et al., 1953; Rohringer et al., 1958; Menon and Schachinger, 1957; de Leo, 1964; van den Briel, 1967). More recently, in plants harvested at different times after inoculation we have observed that an increase in phenols concentration as a response to the infections with *Fusarium oxysporum* f. sp. *lycopersici* is common to both resistant and susceptible plants but whereas in the susceptible plants it occurs slowly but constantly, in the resistant ones it rises to very high levels in the first disease stages and tends to disappear in later stages (Matta et al., 1967).

The inoculation of tomato plants with forms of *Fusarium oxysporum* specific on other hosts but innocuous towards tomato, is followed by changes in the phenols content quite similar to those observed in resistant plants after inoculation with the pathogen (Matta et al., 1969). Also the increase of resistance that is known to be induced by root treatments with α -naphthalene acetic acid in a normally susceptible variety ('Bonner Beste') has been found to be associated with a phenol accumulation initially higher than in the untreated plants (Matta et al., 1969). Even if it is not possible to infer how much the great increase in phenolic compounds, observed a few hours after the infection, could account directly for resistance to *F. oxysporum* in tomato, it is quite evident that it is a constant and typical expression of incompatibility.

The inhibition or delay of this reaction which characterizes the compatible combinations of tomato and *F. oxysporum* could hypothetically depend on: (1) absence in the form *lycopersici* of unspecific stimuli possessed by the non-pathogenic forms, in sufficient amount to promptly induce the response by the susceptible plants, and (2) ability of the form *lycopersici* to inhibit or delay the response.

In an attempt to verify the second of these hypotheses the trend of variations of phenols has been compared in tomato plants of the susceptible variety 'Bonner Beste' inoculated with suspensions of washed conidia of *F. oxysporum* f. sp. *lycopersici* (7.10^6 /

Table 1. Variations of soluble phenols content induced in leaves and stems of 'Bonner Beste' tomato cuttings by infections with *Fusarium oxysporum* f. sp. *dianthi* and *F. oxysporum* f. sp. *lycopersici* and with a mixture of both. Each value is the mean of three determinations.

	Days after inoculation	Control*	Inoculated with the forms:					
			<i>dianthi</i>		<i>lycopersici</i>		<i>dianthi</i> + <i>lycopersici</i>	
			A	B	A	B	A	B
<i>Total phenols</i>								
Leaves	} 1 4	1.17	2.36	2.01	1.60	1.36	1.26	1.07
		2.57	3.20	1.24	3.32	1.29	2.70	1.05
Stems	} 1 4	0.77	1.45	1.88	0.96	1.24	0.91	1.18
		1.02	1.40	1.33	1.64	1.59	1.46	1.46
<i>Orthodihydroxy phenols</i>								
Leaves	} 1 4	0.46	0.75	1.61	0.48	1.04	0.58	1.26
		1.01	1.13	1.11	1.21	1.19	0.97	0.96
Stems	} 1 4	0.24	0.34	1.41	0.26	1.08	0.25	1.04
		0.23	0.22	0.96	0.24	1.04	0.23	1.00

A = mg chlorogenic acid equivalents per g fresh tissue.

B = ratio with the control.

Tabel 1. Verschillen in het gehalte aan oplosbare fenolen in bladeren en stengels van afgesneden tomatenplanten 'Bonner Beste' na infectie met *Fusarium oxysporum* f. sp. *dianthi* en *F. oxysporum* f. sp. *lycopersici* en na infectie met een mengsel van beide. Elk getal vertegenwoordigt het gemiddelde van drie bepalingen.

ml), of *F. oxysporum* f. sp. *dianthi*, a parasite of carnation (7.10^6 /ml), or with a mixture ($7 + 7.10^6$ /ml) of both. Separate determinations of the total soluble phenols and of the orthodihydroxy phenols have been carried out with techniques previously described (Matta et al., 1967) 1 and 4 days after inoculation, in leaves and stems of cuttings inoculated by immersion of their base in the inocula for a period of 2 h.

In all the experiments involving leaves and stems of tomato cuttings the form *dianthi* induced as usual, 24 h after inoculation, greater increases in the total and orthodihydroxy phenols than the form *lycopersici*. The mixture of the two forms, however, was no more effective in stimulating the phenolic reaction than the pathogenic form itself (Table 1). It seems therefore that in presence of the form *lycopersici* the plant loses its ability to react to the non-pathogenic forms.

Comparable results have been obtained by Beckman (1967) in relation to the respiratory burst induced by soil saprophytic micro-organisms in radish seedlings: here again addition in the inoculum of conidia of the pathogen *F. oxysporum* f. sp. *conglutinans* to a mixture of non-pathogens resulted in suppression of the respiratory response.

These observations suggest that compatibility between host and vascular parasites depends on the ability of the latter to delay or inhibit the reactions of the plant.

Samenvatting

De invloed van een inoculatie met een gemengd inoculum van Fusarium oxysporum f. sp. lycopersici en F. oxysporum f. sp. dianthi op het fenolgehalte van tomatplanten

Vormen van *Fusarium oxysporum* welke pathogeen zijn voor andere planten dan de tomaat induceren in deze plant aanvankelijk een grotere toename van het fenolgehalte dan de pathogene f.sp. *lycopersici*. Inoculaties met een gemengd inoculum van de f. sp. *lycopersici* en f. sp. *dianthi* hebben daarentegen geen groter effect op de toename van het fenolgehalte 24 uur na infectie dan de inoculaties met f. sp. *lycopersici* alleen. Verondersteld wordt dat het pathogeen de toename van het fenolgehalte, dat typerend is voor de incompatibele combinatie, kan onderdrukken.

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