Neth. J. Pl. Path. 95 (1989) 357-359 SHORT COMMUNICATION

Allelic test proves genes Cf_4 and Cf_8 for resistance to Cladosporium fulvum (Fulvia fulva) on tomato to be undistinguishable

M. GERLAGH[1], W.H. LINDHOUT[2] and I. VOS[1]

[1] Research Institute for Plant Protection (IPO), P.O. Box 9060, 6700 GW Wageningen, the Netherlands
[2] Institute for Horticultural Plant Breeding (IVT), P.O. Box 16, 6700 AA Wageningen, the Netherlands

Accepted 12 October 1989

Abstract

In an allelic test it was proven that the genes Cf_4 and Cf_8 for resistance to *C. fulvum* in tomato are undistinguishable, confirming a recent suggestion that Cf_8 does not provide a novel source for resistance to *C. fulvum*.

Additional keywords: leaf mold disease, *Lycopersicon esculentum*.

In a recent publication (Lindhout et al., 1989), which confirmed the tomato resistance gene Cf_{11}, effective against the fungal pathogen *Cladosporium fulvum*, as a seperate gene, doubt was expressed as to whether the genes Cf_4 and Cf_8, which are both equally effective against the same range of races, were in fact different genes. The experiments described in that article suggested that both genes were identical, but proof was not available. The present paper fills the gap.

Kanwar et al. (1980) examined the linkage relations of genes Cf_1 to Cf_{11}. They positioned gene Cf_4 on chromosome 1 and Cf_8 on chromosome 9 of tomato. In case of doubt about the results, an allelic test with Cf_4 and Cf_8 can be considered more unambiguous than a linkage test between resistance genes and chromosome markers. To test whether Cf_4 and Cf_8 are distinguishable we therefore made the necessary crosses (at IVT) with material originally obtained from E.A. Kerr, one of the authors of the publication mentioned, and screened for resistance to *C. fulvum* (at IPO). Twenty days old tomato seedlings in the two leaves stage were sprayed with a spore suspension of *C. fulvum*, incubated at 100% RH for two days, maintained in a glasshouse at 20 °C, and scored for resistance (R) or susceptibility (S) at 14 days after inoculation. (For details: see Lindhout et al., 1989). The results are given in Table 1. In no instance did we find the segregation of resistant and susceptible plants which would be expected if genes Cf_4 and Cf_8 are different genes for resistance. The absence of resistance of 'Ontario 7522' and of resistant plants in the F_1 {MM × (P × O)} and F_2 when screened with race 4, and of susceptible plants in these populations when screened with races 2 or 5 is a very strong evidence that the genes Cf_4 and Cf_8 are one and the same gene. Even when Cf_4 and Cf_8 would have identical functions, but be located on different chromosomes, segregation would be expected when testing the F_1 {MM × (P × O)}

Table 1. Allelic test for resistance genes Cf_4 and Cf_8.

Cultivars and populations	Res. genes	Interactions with *C. fulvum* races 2, 4 and 5								
		observed[1]			expected[2]					
					if $Cf_4 \neq Cf_8$			if $Cf_4 = Cf_8$		
		2	4	5	2	4	5	2	4	5
Moneymaker (MM)	—	9S	9S	9S						
Purdue 135 (P)	Cf_4	21R	24S	20R						
Ontario 7522 (O)	Cf_8	14R	15S	15R	R	R	R	R	S	R
Ontario 7719	Cf_9	9R	9R	9R						
F_1 (P × O)		15R	15S	15R	R	R	R	R	S	R
F_2 (O × P)[3]		147R	151S	150R	15R:1S	3R:1S	15R:1S	R	S	R
F_1 {MM × (P × O)}		52R	30S	30R	3R:1S	1R:1S	3R:1S	R	S	R

[1] Numbers refer to the number of screened plants.
[2] Only discriminating expected ratios are presented.
[3] As Cf-genes are nuclear encoded no reciprocal effects are expected when the F_2 (O × P) is used instead of F_2 (P × O).

or F_2 populations with race 2 or 5 (not shown). Cf_4 and Cf_8 might also be very tightly linked genes with identical functions. However, as long as no recombination between these two putative genes has been found, Cf_4 and Cf_8 should be considered as one gene.

Our data are based on sufficiently large numbers of plants to neglect the chance of missing segregation. Another fact, supporting the hypothesis of one single gene instead of two, is the reproducible observation, also by many others, that Cf_8 does not protect plants to infection by race 4.

In conclusion, there is not the slightest evidence from our research or from other literature that supports Kanwar et al.'s (1980) identification of separate genes. We propose to use 'Cf_4' to indicate the *Cladosporium* resistance gene present in 'Purdue 135' and in 'Ontario 7522'.

Acknowledgements

The authors wish to express their thanks to Gerard Pet for obtaining the F_1 and F_2 populations.

Samenvatting

Genen Cf_4 en Cf_8 voor resistentie tegen Cladosporium fulvum (Fulvia fulva) van tomaat blijken in een allelie-toets niet te onderscheiden

In een allelie-toets werd aangetoond dat de genen Cf_4 en Cf_8 voor resistentie tegen *C. fulvum* van tomaat niet te onderscheiden zijn. Hiermee werd een recente suggestie bevestigd, dat Cf_8 geen nieuwe resistentie tegen *C. fulvum* verschaft.

References

Kanwar, J.S., Kerr, E.A. & Harney, P.M., 1980. Linkage of Cf_1 to Cf_{11} genes for resistance to tomato leaf mold, *Cladosporium fulvum* Cke. Tomato Genetics Cooperative Report 30: 20-21.

Lindhout, P., Korta, W., Cislik, M., Vos, I. & Gerlagh, T., 1989. Further identification of races of *Cladosporium fulvum* (*Fulvia fulva*) on tomato originating from the Netherlands, France and Poland. Netherlands Journal of Plant Pathology 95: 143-148.