

Race 2.5.9, a new race of *Cladosporium fulvum* (*Fulvia fulva*) and sources of resistance in tomato

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Cladosporium fulvum (*Fulvia fulva*) is well known for its remarkable capacity to overcome resistance genes introduced by breeders.

In France, as in most countries where the culture of greenhouse tomatoes is widespread, cultivars carrying one of the genes Cf2, Cf4 or Cf5 are sometimes infected. Race 2.4, which is capable of overcoming the Cf2 Cf4 combination, has frequently been isolated in a number of countries, including France (Laterrot et al., 1979). Recently, race 2.5, which is capable of overcoming the combination of Cf2 and Cf5, made its appearance in tomato crops in Bulgaria and France (Laterrot et al., 1985). A race with an even wider virulence spectrum, viz. race 2.4.5, had already been isolated from crops in the Netherlands in 1977 (Hubbeling, 1978).

After plant breeders have started to introduce newly described genes into their cultivars, which was possible by work of Kanwar et al. (1980 a,b) in Canada, a highly developed race appeared in the greenhouses of the Institute for Horticultural Plant Breeding, Wageningen, the Netherlands, viz. race 2.4.5.9, which was capable of overcoming the combination of Cf2, Cf4, Cf5 and Cf9 (Boukema, 1981). This race, however, has never been isolated from commercially-grown greenhouse tomato plants, and the so-called 'C5' (Laterrot, 1981a) commercial cultivars (with gene Cf9 or another gene giving resistance against race 2.4.5) continued to be healthy in practice. This situation changed in France in 1985, when *C. fulvum* appeared on 'Rianto F1' grown in a greenhouse in Brittany. ('Rianto F1', a C5 resistant cultivar, is grown under cover in western France in summer and autumn).

Inoculation of a set of differential cultivars with an isolate from 'Rianto F1' revealed that the race in question attacked cultivars with genes Cf2, Cf5, Cf9 and those with a combination of Cf2 and Cf5. During this study, a re-isolate of *C. fulvum* from conidia formed on the ONT 7719 line (carrying gene Cf9) was obtained. This re-isolate showed the same virulence spectrum as the original isolate from 'Rianto F1'. It can be concluded that the race in question is of the 2.5.9 type. A series of lines at present under study in relation to *C. fulvum* isolates from French greenhouses (Laterrot, 1981b), was inoculated with the re-isolate of 2.5.9. The results are given in Table 1.

Race 2.5.9 appeared in 1985 on 'Rianto F1' grown on the same farm from which race 2.5 was isolated in 1984. Race 2.5 had been isolated from 'Prisca F1' carrying gene Cf5 (Laterrot et al., 1985). In the same area, race 5 had been isolated in 1977 on a cultivar which had no *C. fulvum* resistance gene. The analysis of the situation which led to the appearance of race 2.5.9 is complicated by the fact that the resistance genes of the

Table 1. Reaction of different lines and hybrids of tomato to inoculation with race 2.5.9 of *Cladosporium fulvum*.

Names	Resistance genes	Reaction ¹
Monalbo	none	S
Vetomold	Cf2	S
Purdue 135	Cf4	R
Vagabond	Cf2, Cf4	R
PI 187002-1	Cf5	S
F1 Vetomold × PI 187002-1	Cf2, Cf5	S
F1 Vagabond × PI 187002-1	Cf2, Cf4, Cf5	R
F 77-38 (origin : PI 211839)	Cf6	R
ONT 7719 (origin : PI 126933)	Cf9	S
IVT 1154 (origin : PI 126915)	Cf9	S
F1 F77-38 × ONT 7719	Cf6, Cf9	R
Bulgaria no 1	?	R (IN)
IVT 1150 (origin : Alex E)	?	R (B)
IVT 1151 (origin : 63280)	?	R (B)
IVT 1152 (origin : 64316)	?	R (B)
IVT 1153 (origin : 66063)	?	R (BS)
Japan 74 S	?	R
Japan 76 S	?	R
ONT 7515	Cf7	R (B)
ONT 792	Cf10	R (B)
ONT 798	Cf12	R (B)
ONT 7813	Cf13	R
ONT 7814	Cf14	R (B)
ONT 7816	Cf16	R (B)
ONT 7519	Cf19	R
ONT 7811	Cf21	R (B)
ONT 7523	Cf23	R

¹ R) resistance (no symptoms); R (IN)) resistance (punctiform necrosis); R (B)) resistance (white areas with mycelium); R (BS)) resistance (white areas with mycelium and very slight sporulation); S) susceptibility (abundant sporulation).

‘Rianto F1’ are not known. The present results show that it should at least carry gene Cf9.

Part of the resistance sources at present under study are resistant to race 2.5.9. The results obtained confirm those of Boukema (1981) with Bulgaria no 1, Japan 74S and Japan 76S which were included in her study with race 2.4.5.9.

The appearance in practice of the new race 2.5.9 underlines once again that it is highly preferable to include at least two ‘new’ resistance genes in new cultivars in an attempt not only to improve the management of available genetic resistance sources, but also to prolong the commercial life of such cultivars.

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Samenvatting

Een nieuw fyso, 2.5.9, van Cladosporium fulvum (Fulvia fulva), en resistentiebronnen in tomaat

Cladosporium fulvum staat bekend om zijn vermogen zich snel aan te passen aan nieuw geïntroduceerde resistentiegenen. De laatste jaren bleven tomaterrassen met 'C5 resistentie' in de praktijk resistent. Deze rassen zijn zelfs resistent tegen het complexe fyso 2.4.5 door het bezit van Cf9 of een ander resistentie-gen. Een fyso 2.4.5.9 trad weliswaar op bij proeven op het IVT (Wageningen), maar werd nooit in de praktijk gevonden.

In 1985 werd in Frankrijk het ras Rianto F1 in een praktijkteelt aangetast. Een isolaat van *C. fulvum* van dit C5-resistente ras bleek fyso 2.5.9 te zijn. Een deel van de thans bij onderzoek gebruikte resistentiebronnen, zoals Bulgaria no. 1, Japan 74S en Japan 76S, is resistent voor dit nieuwe fyso.

Het optreden van dit nieuwe fyso onderstreept de wenselijkheid ten minste twee 'nieuwe' resistentiegenen in nieuwe rassen te gebruiken ter verbetering van de duurzaamheid van de resistentie.

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