

Evaluation of strawberry cultivars for resistance to *Verticillium dahliae* Kleb.

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Abstract

Verticillium dahliae Kleb. is a soil-borne pathogen which causes worldwide economically important plant and yield losses. So far no resistance preventing the fungus from growing in the plants could be found in the genus *Fragaria*. But there are cultivars with different levels of tolerance.

In particular after the ban on chemical control with effective soil disinfectants (methylbromid) cultivation methods and the breeding of tolerant cultivars become important.

In this experiment, 21 strawberry cultivars were inoculated under greenhouse conditions with a suspension of seven *Verticillium dahliae* isolates from various regions of Germany and from Poland. The isolates belong to different genetic groups as first investigation by RAPD analysis reveals.

After resistance evaluation strawberry cultivars were scored in three resistance classes: "highly tolerant", "medium susceptible" and "highly susceptible".

Keywords: *Fragaria*, *Verticillium*-Wilt

Introduction

The strawberry is the most important soft fruit variety worldwide. So far the breeding of new strawberry cultivars was focused on large and firm fruit, high yield and good shelf life. Other properties such as high-quality flavour and resistance to diseases have been partially neglected (Olbricht et al. 2006; Olbricht et al. 2008).

A major disease in strawberry production is the *Verticillium*-wilt. The causal organism is the soil borne pathogen *Verticillium dahliae* Kleb. (Büttner 1985; Hallmann et al. 2007) which occurs in nearly all soils. The fungus has a very large host range and can survive in the soil about 15 years by microsclerotia (Naumann & Seipp 1989; Lieten 1998; Neubauer 1999; Jung 2003).

One reason for high yield losses due to this pathogen may be the cultivation of highly susceptible cultivars, such as the widely distributed cultivar 'Elsanta' (Neubauer 2001; Jung 2003). Already Thomas (1932) described the symptoms of wilting plants in strawberry fields in the USA, Canada, England and Scotland, which were attributed to a *Verticillium*-infection.

The aim of the experiment was to test new and known strawberry cultivars for resistance to *Verticillium dahliae* Kleb.

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Material and Methods

Frigo plants (quality A) of the cultivars 'Judibell', 'Florence', 'Symphony', 'Malwina', 'Mieze Nova', 'Daroyal', 'Asia', 'Elianny', 'Victoriana', 'Mieze Schindler', 'Camarosa', 'Elsanta', 'Senga Sengana', 'Candonga', 'Cristal' and 'Donna' were used for the experiment.

The cultivar 'Senga Sengana' was taken as standard cultivar for high tolerance and 'Elsanta' as a susceptible cultivar.

All strawberries were potted in 12 cm pots with a substrate-sand mixture (substrate A250 Company Stender) and were pre-cultivated in the greenhouse.

The seven used *Verticillium dahliae*-isolates originate from various regions of Germany and from Poland. They can be grouped into different genetic groups by RAPD-PCR fingerprint a first investigation reveals.

The *Verticillium*-isolates were cultivated on CZAPEK-DOX-Agar at 23°C with 16h light. Differences in the production of microsclerotia were observed. A fungal suspension including conidia and microsclerotia of the seven isolates was used for inoculation. The density of the suspension was about 10⁶ conidia per millilitre.

Before inoculation, the plants were potted out and their roots were cleaned from soil with water. One third of the length of the roots was cut off. Ten plants of each cultivar were placed with their roots into the *Verticillium*-suspension. Five control plants were placed in water. After 24 hours the plants were potted again and watered with the rest of the fungal suspension – about 50 ml per plant 24 hours later. During the experiment plants were watered if necessary. The evaluation and score system used for evaluation of vegetative symptoms (wilting symptoms and leaf dying) is shown in Table 1.

Table 1: Evaluation scale of wilting symptoms.

Evaluation score	Scale of symptoms
1	no symptoms
3	wilting symptoms on single outer leaves
5	all outer leaves are wilting
7	all outer leaves are wilting, except heart leaves
9	plant dead
-	unvalued

The first evaluation was done 12 days after inoculation followed by further nine evaluations, three per week. Additionally the strawberry cultivars were grouped in three resistance classes: "highly tolerant" (no test plant dead), "medium susceptible" (up to five test plants dead) and "highly susceptible" (more than five test plants dead).

To confirm the infection by the fungus in the inoculated plants it was tried to re-isolate *Verticillium* from petioles.

Results

In the greenhouse tested strawberry cultivars were scored in the resistance classes as shown in Table 2.

Table 2: Classification of strawberry cultivars into three resistance classes.

high tolerance	Omedium susceptibility	high susceptibility
`Judibell´	`Malwina´	`Candonga´
`Mieze Nova´	`Asia´	`Florence´
`Cristal´	`Senga Sengana´	`Elsanta´
	`Elianny´	`Symphony´
	`Mieze Schindler´	`Camarosa´
	`Donna´	`Daroyal´
	`Victoriana´	

Discussion

For strawberry growing and for further breeding it is important to collect knowledge about tolerance or susceptibility of cultivars against *Verticillium*. Studies about inheritance of resistance suggest a quantitative inheritance (Büttner 1985). The range of susceptibility of symptoms from highly tolerant to highly susceptible in this study is also indicating a quantitative inheritance. Such cultivars like 'Elsanta', 'Florence', 'Daroyal' have the susceptible cultivar 'Gorella' in their breeding line.

Re-isolation of *Verticillium* was successful in all cultivars except in 'Judibell', 'Mieze Nova', 'Elianny' and 'Candonga'. Probably the fungus had not grown yet into the petioles used.

However, the infestation with the fungi was strong enough to cause wilting symptoms and growth depressions in 'Judibell', 'Mieze Nova' and 'Elianny'. The robustness and disease tolerance of a cultivar is an important criterion for crop recommendation. The highly tolerant cultivars 'Judibell', 'Mieze Nova' and 'Cristal' can be suggested for fields with *Verticillium* infestation. The majority of the tested cultivars are medial or highly susceptible. These cultivars will show problems on production sides in presence of *Verticillium*. A second trial is necessary to confirm the presented results.

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