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# Characteristics and pathogenicity of six Phytophthora isolates from pot plants

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**Abstract**

From several greenhouse plants showing foot and root rot symptoms *Phytophthora* isolates were gathered. Isolates from *Peperomia, Saintpaulia* and *Sinningia* were identified as *P. nicotianae* van Breda de Haan var. *nicotianae* and an isolate from *Begonia* as *P. cryptogea* Pethybr. & Laff. Cardinal temperatures for the various isolates were determined. The specific and non-specific pathogenicity of the isolates was studied by inoculating the different crops with the different isolates, including a *P. cryptogea* isolate from *Gerbera* and a *P. nicotianae* var. *nicotianae* isolate from carnation.

The *P. nicotianae* var. *nicotianae* isolates appeared to be morphologically identical. Some of the isolates were similar in host range, but others exhibited differences in host specificity at 20° C as well as 25, 30 or 35° C. The same applies for the two *P. cryptogea* isolates.

*Additional keywords: Begonia, Kalanchoë, Peperomia, Saintpaulia, Sinningia, Gerbera,* carnation.

## Introduction

In the Netherlands potplant growing has expanded largely during the last 5-10 years. Several of these crops can be attacked by *Phytophthora* species. The importance of losses due to *Phytophthora* attacks has increased following the expansion of potplant growing. Especially in crops like *Begonia, Kalanchoë, Peperomia, Saintpaulia* and *Sinningia* heavy losses occur. Diseases caused by *Phytophthora* have been recorded by various authors (Kröbe and Plate, 1973; Siradhana et al., 1968; Pape, 1937). Some of these diseases have also been found in the Netherlands (Rattink and Speerstra, 1975).

The pathogenicity of *P. cryptogea* to *Gerbera* is generally known. Attacks of carnation by *P. nicotianae* have been established in the Netherlands since 1977 (Rattink, 1979). The aim of this work, started in 1978, was to establish the specific host-*Phytophthora* combinations occurring in Dutch potplant culture, and to establish the specific or non-specific pathogenecity of the *Phytophthora* species isolated.

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## Materials and methods

Plants suspected of an attack by *Phytophthora* were gathered from commercial nurseries. Diseased plants showing symptoms as described by Kröber and Plate (1973) for *Saintpaulia*, by Siradhana et al. (1968) for *Peperomia* and by Pape (1937) for *Sinningia* were chosen. Plants of *Begonia* and *Kalanchoë* were selected when they showed a rot on the base of the plant or a general decay.

The pathogens were isolated from the various crops on potato dextrose agar (PDA, Difco) and maintained on oatmeal agar (OA, Difco). The influence of the temperature on mycelial growth was determined in vitro by culturing the pathogens on OA and incubating the plates at a series of different temperatures. Radial mycelial growth was measured. For the inoculation experiments inoculum was grown for ten days at 23 °C on solid OA or in a standing culture of Richards'-solution. The contents of a one litre flask of liquid solution and five petri dishes with a diameter of 9 cm were homogenized and diluted with 3 l of sterilized water. 50 ml of this suspension were added as inoculum to the soil in each pot. In each treatment 40-50 pots were used.

Young plants of *Begonia hiemalis* 'Schwabenland', *Kalanchoë blossfeldiana* 'Eldorado', *Peperomia obtusifolia* 'USA', *Saintpaulia ionantha* 'Christina' and 'Eva' and the *Sinningia*-hybrid 'Anja Egels' were obtained from commercial nurseries for the inoculation experiments. They were transplanted in pots with a diameter of 8 or 10 cm and grown in a greenhouse at 20-25 °C.

Diseased plants were examined and the identity of isolated fungi was determined.

## Results

*Collection and identification.* From most diseased plants of *Saintpaulia, Peperomia* and Sinningia a *Phytophthora* species was isolated. From *Begonia* plants, a *Phytophthora* species was isolated in only a few cases. Here mostly other pathogens, like *Fusarium, Cylindrocarpon* or *Rhizoctonia,* seemed to be the cause of the problem. The same pathogens were found on *Kalanchoë.* No *Phytophthora* was found in this crop.

These *Phytophthora* isolates as well as isolates from *Gerbera* and carnation, as references, were identified at the Centraalbureau voor Schimmelcultures (CBS) at Baarn, the Netherlands as follows:

| | | |
|---|---|---|
| *Begonia* | : *P. cryptogea* Pethybr. & Laff. | |
| *Peperomia* | : *P. nicotianae* van Breda de Haan | var. *nicotianae* type A1 |
| *Saintpaulia* | : *P. nicotianae* | var. *nicotianea* type A2 |
| *Sinningia* | : *P. nicotianea* | var. *nicotianea* type A2 |
| *Gerbera* | : *P. cryptogea* | |
| Carnation | : *P. nicotianae* | var. *nicotianae* type A2 |

*Influence of temperature.* The influence of the temperature on the mycelial growth of the above mentioned isolates was determined in vitro by culturing the fungi on OA at temperatures ranging from 2 to 40 °C.

The data obtained are presented in Fig. 1, each point representing the mean of five to seven replicates of one treatment in one experiment.

The cardinal temperatures (°C) for the various isolates appeared to be:

| | min. | opt. | max. |
|---|---|---|---|
| *P. nicotianae* var. *nicotianae* A2 from *Sinningia* | 9 | 25-30 | ca. 36 |
| *P. nicotianae* var. *nicotianae* A2 from *Saintpaulia* | 9 | 25-30 | ca. 36 |
| *P. nicotianae* var. *nicotianae* A2 from carnation | 4 | 20-26 | ca. 37 |
| *P. nicotianae* var. *nicotianae* A1 from *Peperomia* | 9 | 35 | ca. 37 |
| *P. cryptogea* from *Begonia* | 2 | 20-26 | ca. 37 |
| *P. cryptogea* from *Gerbera* | 2 | 20-26 | ca. 37 |

The data for the *P. cryptogea* isolates and two of the *P. nicotiana* isolates (from *Saintpaulia* and *Sinningia)* agree with those given by Waterhouse (1963).

However, the optimal temperatures of the isolates from *Peperomia* and carnation differ considerably.

*Host specificity.* In a series of experiments in a greenhouse, the above mentioned crops were inoculated with the six *Phytophthora* isolates to establish the pathogenicity of the isolates to the various crops. The influence of the temperature on pathogenicity was determinated by placing the inoculated potted plants into benches filled with peat and heated electrically to 20, 25, 30 or 35 °C. The results are compiled in Table 1. The *Phytophthora* isolates varied considerably in pathogenicity. None of the tested crops was attacked by the *P. nicotianae* isolate from carnation, except *Begonia* and *Sinningia* at high temperature. The isolates from *Peperomia* and *Sinningia* were more or less pathogenic on all crops, except on *Kalanchoë,* although there was much variation in pathogenicity on the different crops. The isolate from *Saintpaulia* was only pathogenic to *Saintpaulia* and *Sinningia.*

There were also difference in pathogenicity on the various crops between the *P. cryptogea* isolates from *Begonia* and *Gerbera.* Both were equally pathogenic to *Begonia;* but the *Begonia* isolate was further more only pathogenic to *Sinningia* and the *Gerbera* isolate only to *Peperomia.*

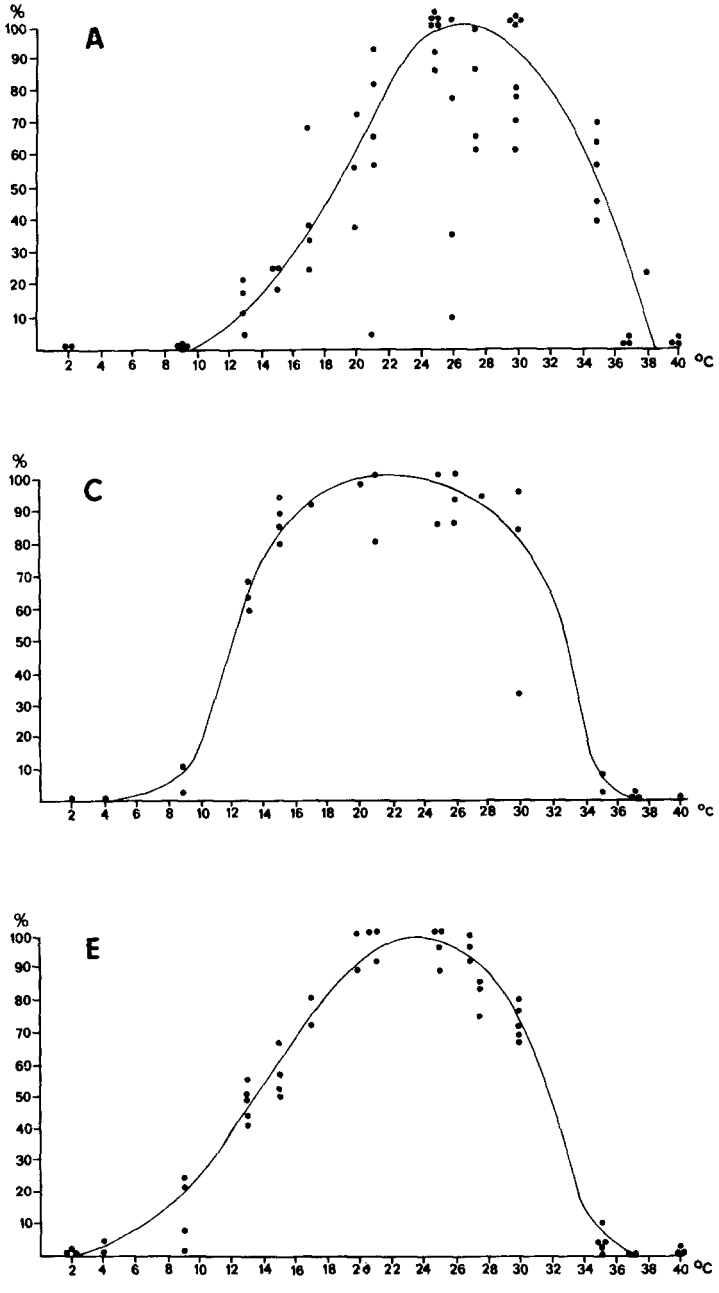
*Kalanchoë* was not susceptible to any of the tested isolates. The susceptibility of *Begonia* was rather moderate to all tested isolates. *Sinningia* was very susceptible to all isolates tested except the carnation and the *Gerbera* isolate. *Peperomia* and *Saintpaulia* were more or less susceptible to the different isolates. All tested crops were highly susceptible to their own isolates.

Generally the disease ratings were the same at the various temperatures. There were only slightly higher disease rating at higher temperatures. *Begonia* and *Sinningia* were attacked by isolates from *Saintpaulia* and carnation at 35 °C, where as they are not attacked by these isolates at lower temperatures.

## Discussion

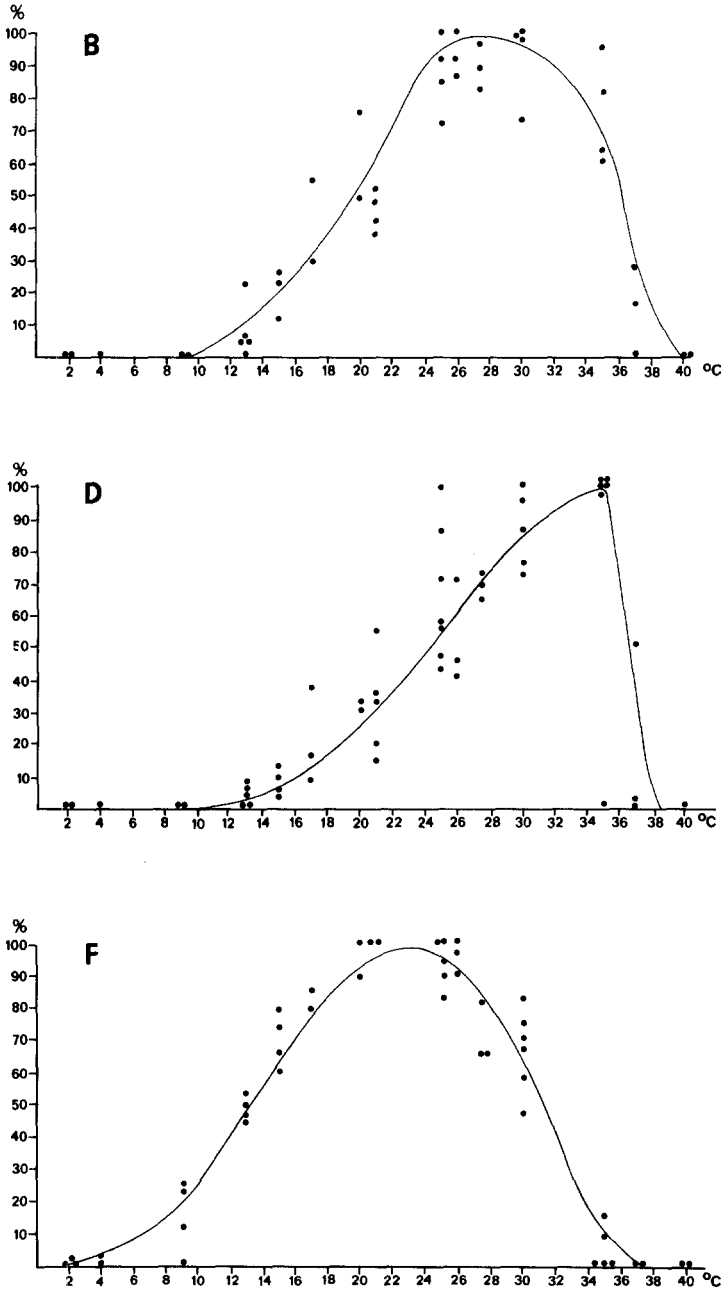
*Phytophthora* isolates, obtained from diseased plant of *Peperomia, Saintpaulia, Sinningia* and carnation, were identified as *P. nicotianae* var. *nicotianae.* Although their morphological properties were within the ranges given by Waterhouse (1963), the isolates appeared to be physiologically different. When grown on culture media the isolates showed differing growth curves and cardinal temperatures. The *Phy-*

Fig. 1. Growth of *P. nicotianae* var. *nicotianae* and *P. cryptogea* isolates in vitro at different temperatures (in % of maximal growth).




A = *P. nicotianae* var. *nicotianae* A2 from *Sinningia*
C = *P. nicotianae* var. *nicotianae* A2 from carnation
E = *P. cryptogea* from *Begonia*

*Fig. 1. Groei van P. nicotianae var. nicotianae en P. cryptogea isolaten bij verschillende temperaturen (in % van maximale groei).*




B = *P. nicotianae* var. *nicotianae* A2 from *Saintpaulia*
D = *P. nicotianae* var. *nicotianae* A1 from *Peperomia*
F = *P. cryptogea* from *Gerbera*

Table 1. Pathogenicity of 4 isolates of *P. nicotianae* var. *nicotianae* and 2 isolates of *P. cryptogea* to some potplants at 4 temperatures(°C).

| | Disease rating[1] on | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Begonia* | | | | *Peperomia* | | | | *Saintpaulia* | | | | *Sinningia* | | | | *Kalanchoë* |
| Soil temp. | 20° | 25° | 30° | 35° | 20° | 25° | 30° | 35° | 20° | 25° | 30° | 35° | 20° | 25° | 30° | 35° | 20° |
| *P. cryptogea* from *Begonia* | ± | – | ± | ++ | – | – | – | – | – | – | – | – | ++ | ++ | ++ | ++ | – |
| *P. cryptogea* from *Gerbera* | ± | | | | ++ | | | | ± | | | | – | | | | – |
| *P. nicotianae* from *Peperomia* | ± | – | – | – | ++ | ++ | ++ | ++ | ± | – | – | – | ++ | ++ | ++ | ++ | – |
| *P. nicotianae* from *Saintpaulia* | – | – | – | + | – | – | – | – | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | – |
| *P. nicotianae* from *Sinningia* | ± | – | ± | – | + | ++ | + | ++ | ± | – | – | – | ++ | ++ | ++ | ++ | – |
| *P. nicotianae* from carnation | – | – | – | ± | – | – | – | – | – | – | – | – | – | – | – | ++ | – |

1 Disease ratings 2-3 months after inoculation: – = 0-10%, ± = 11-25%, + = 26-50%, ++ = 51-100% diseased plants.

*Tabel 1. Pathogeniteit van 4 isolaten van P. nicotianae var. nicotianae en 2 isolaten van P. cryptogea voor enkele potplanten.*

*tophthora* isolate from *Begonia* was identified as *P. cryptogea,* not differing morphologically and physiologically from other *P. cryptogea* isolates.

Although *Phytophthora* is indicated as the causal agent of foot rot on *Kalanchoë* (Wittmann, 1972), *Phytophthora* was not isolated from plants of *Kalanchoë* showing a rot on the base of the stem. Also plants of *Kalanchoë* were not infected by the *Phytophthora* isolates in the inoculation trials. This confirm earlier observations made by Rattink and Speerstra (1975).

All *P. Nicotianae* isolates had a more or less different host range, but none was host specific. The isolates from *Peperomia and Sinningia* were similar in host range, the isolates from carnation and Saintpaulia each different from the other two. This behaviour was about the same at different temperatures. Only the isolates from carnation infected *Sinningia* and to some extent *Begonia* at high temperature, whereas it was not pathogenic at normal temperatures.

The two isolates of *P. cryptogea* varied in host range.

It is evident that several isolates of *P. nicotianae* are pathogenic on more than one type of plant commonly found in greenhouses. Because of its wide distribution, host range and pathogenic variability, *P. nicotianae* var. *nicotianae* can be a serious problem in greenhouse crop production. More work will be needed to determine if real pathogenic types can be identified.

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**Samenvatting**

*Eigenschappen en pathogeniteit van zes Phytophthora isolaten bij potplanten*

Van verschillende potplanten met voet- en wortelrotsymptomen werden *Phytophthora*-isolaten verzameld. De isolaten van *Peperomia, Saintpaulia* en *Sinninga* werden gedetermineerd als *P. nicotianae* var. *nicotianae* en het isolaat van *Begonia* als *P. cryptogea.* Van deze isolaten en van een *P. nicotianae*-isolaat uit anjer en een *P. cryptogea*-isolaat uit *Gerbera* werden de kardinale temperaturen bepaald en door middel van kruisinoculaties de pathogeniteit ten opzichte van enkele waardplanten. De pathogeniteit ten opzichte van de verschillende gewassen bleek verschillend te zijn. Deze verschillen waren hetzelfde bij temperaturen van 20, 25, 30 of 35 °C.

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# Book review

R. Bovey, W. Gärtel, W. B. Hewitt, G. P. Martelli and A. Vuittenez, 1980. Maladies à virus et affections similaires de la vigne; atlas en couleurs des symptomes. Virosen und virusähnliche Krankheiten der Rebe; Farbatlas der Symptome. Virus and virus-like diseases of grapevines; colour atlas of symptoms. Editions Payot, Lausanne/La Maison Rustique, Paris/Verlag Eugen Ulmer, Stuttgart. 181 pp., 186 photographs in colour, 1 table and index. DM 58.

The grapevine, having been vegetatively propagated for hundreds of years, is bound to be overrun by viruses. Indeed some 30 important virus or virus-like diseases have already been described in this crop. They often considerably reduce yield and quality and their accumulation leads to cultivar degeneration.

Sofar only twenty diseases have been proved to be actually associated with viruses. A few, previously thought to be caused by virus, are now attributed to procaryotic Mycoplasma and Rickettsia-like micro-organisms. Study of these disease in the field and proof of virus freedom of propagation stock, used for disease prevention, still is largely by examination for symptoms on field-grown cultivars or on special *Vitis* species used as indicators. Illustrations of symptoms in colour (186 in total) therefore constitute the major part of the present book (ca. 100 pages). They help to distinguish virus diseases from disorders due to certain pests (toximios), mineral deficiences, pesticides, genetic abberrations or climatic influences.

There are three short introductory chapters ont the diseases caused by viruses transmitted by nematodes, soil fungi, aphids, and by unknown vectors, on diseases caused by Mycoplasma- and Rickettsia-like organisms and on virus-like disorders. The book terminates with a helpful tabular survey of the viruses and virus diseases of the crop and of their main characteristics, and with an alphabetical index.

The authors' reputation for their research on grapevine viruses and virus diseases in Switzerland, Germany, USA, Italy and France warrants the quality of the information from a wide range of sources. Layout and printing are of high quality. The book will be indispensable for all concerned with crop protection of grapevine. Publication of the entire text and all legends in French, German and English aims at a wide reading public.

L. Bos