Research Institute of Pomology and Floriculture, Skierniewice, Poland

OCCURRENCE AND HARMFULNESS OF *PHYTOPHTHORA CITROPHTHORA* TO SOME *SAXIFRAGA* SPECIES AND CULTIVARS IN POLAND

M. Ptaszek

Abstract

Phytophthora citrophthora was isolated from the most of analysed *Saxifraga* plants with symptoms of black leaf spot and stem base rot as well as from the substratum. In infection experiments the species colonized all tested *Saxifraga* species and cultivars but the quickest spread of necrosis was observed on *S. arendsii* 'Rot', *S. cotyledon* 'Pyramidalis' and *S. paniculata* 'Bis'. The data obtained pointed to significant differences in the tissue colonization of *Saxifraga* species by *P. citrophthora* at the temperature 7.5 to 32.5°C, with the optimum 25–30°C.

Key words: *Phytophthora citrophthora*, isolation, *Saxifraga* spp., colonization, necrosis, temperature

Introduction

Every year, several millions of perennial plants are produced in Polish hardy nursery stocks and their area systematically increases. Great diversity of species and cultivars, blooming from early spring till late autumn are the reason of their cultivation on balconies, terraces, gardens and plots. So far, in Poland no problems with perennial plants health were observed. The import of new cultivars and species, as well as propagation material, resulted in the brought of severe soil-borne pathogens, especially *Phytophthora* spp. and *Rhizoctonia solani* (Orlikowski 2006). Observation of health status of perennial plants during the past two years showed the occurrence of root, stem base and leaf rot on some of them and *P. cryptogea* was the predominant agent isolated from *Sempervivum*, *Aquilegia* and *Saxifraga* species (Orlikowski and Ptaszek 2007).

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In the years 2005–2007 great losses resulting from *Saxifraga* species mortality in ornamental nurseries were observed. Depending on cultivars and growth dynamics of plants, the symptoms were differentiated. The most often observed ones were yellowing and browning of leaves starting from the petiole base. Additionally stem base and root rot were noticed. The objective of this study was to determine the causal agent of *Saxifraga* leaf and root rot.

Material and methods

Isolation of microorganisms from diseased plants

For mycological analysis plants were taken from June to September 2005–2007 from three hardy nursery stocks. Diseased plants or their parts were collected into plastic bags and transferred to the laboratory. Fragments of plants were washed under tap water, rinsed in distilled water and after blotting dried and sterilized over a burner flame. Then 5 mm diameter fragments of tissues were put on potato dextrose agar (Orlikowski and Szkuta 2002). Colonies grown around the inocula were transferred into PDA slants. After seven days cultures obtained were grouped and selected isolates were identified to genera and species on the base of their morphology. The results were confirmed using RAPD-PCR (Trzewik et al. 2006) and PCR with species-specific primers for *P. citrophthora* Ctph1/Ctph2 (Ersek et al. 1994).

Isolation of *Phytophthora citrophthora* from the substratum

The baiting technique with rhododendron leaves cv. 'Nova Zembla' was used for substratum analysis (Orlikowski and Ptaszek 2008). The substratum taken from pots with diseased plants was put into ash tray and flooded with tap water. Young rhododendron leaves cv. 'Nova Zembla' were transferred into water and trays were covered with foil. After four-day-long incubation fragments of leaves with necrotic spots were put on PDA medium and *Phytophthora* colonies appeared. The isolates obtained were identified to species using the same procedure as with mycological analysis of plant materials.

Colonisation of *Saxifraga* spp. leaves by *Phytophthora citrophthora*

In the laboratory trials the isolate of *P. citrophthora* from *Saxifraga paniculata* 'Bis' was used. Bases of leaf blades, placed in ash tray covered with moist blotting paper and plastic net, were inoculated with 3 mm diameter fragments taken from the edge of seven-day-old *Phytophthora* sp. culture growing on PDA, and covered with foil (Orlikowski and Szkuta 2002). After three and six days of incubation at 22–24°C the length of necrosis was measured. Experimental design was completely randomized with four replications and 10 leaf blades in each replication. Trials were repeated at least twice.

Influence of temperature on colonisation of *Saxifraga* leaves inoculated with *Phytophthora citrophthora*

In this study *S. arendsii* 'Peter Pan' and *S. paniculata* 'Bis' were used. The method described above with colonisation of leaves by the species was used. Trays with plant parts inoculated by *P. citrophthora* were incubated at 7.5–32.5°C. After three and six days of incubation the length of necrosis was measured. Experimental design was completely randomized with four replications and five plant fragments in each replication. Trials were repeated at least twice.

Results

Phytophthora citrophthora was isolated from 3/4 of the analyzed plants. Additionally *Alternaria alternata, Botrytis cinerea, Rhizoctonia solani, Mucor* spp. and *Penicillium* spp. were isolated from the diseased tissues.

Results of laboratory trials on colonisation of *Saxifraga* tissues by *P. citrophthora* showed significant differences in pathogenicity of this culture towards all species and cultivars of *Saxifraga*. After three and six days of incubation the quickest spread of necrosis was observed on *S. arendsii* 'Rot', *S. cotyledon* 'Pyramidalis' and *S. paniculata* leaves whereas the slowest – on *S. arendsii* 'Peter Pan' and 'Aureovariegata' (Fig. 1).

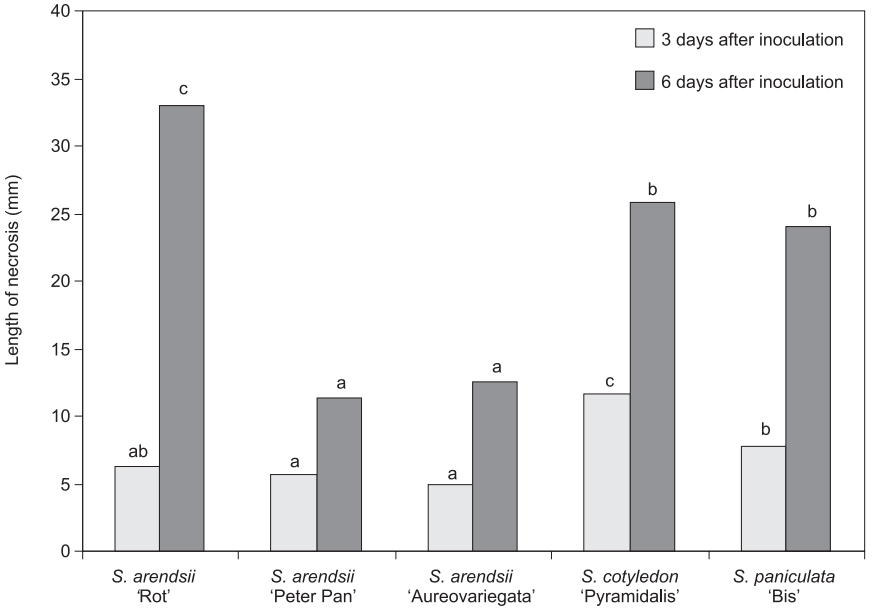

Fig. 1. Colonisation of *Saxifraga* spp. leaf blades by *Phytophthora citrophthora* isolate from *Saxifraga paniculata* (mean values followed by the same letter do not differ with 5% of significance – Duncan's multiple range test)

Table 1

Length of necrosis on leaf blades of two *Saxifraga* species colonized by *Phytophthora citrophthora* isolate from *Saxifraga paniculata*, in relation to temperature three (A) and six (B) days after inoculation (mm)

Temperature (°C)	*S. arendsii* 'Peter Pan'		*S. paniculata* 'Bis'	
	A	B	A	B
7.5	0 a	2.0 a	0 a	2.5 a
10	0 a	6.0 b	4.3 b	9.0 b
15	2.0 b	7.8 b	5.0 bc	9.9 b
20	8.3 c	11.0 c	9.5 d	16.6 c
25	9.1 cd	17.0 e	16.4 e	19.3 d
27.5	10.8 d	18.3 e	17.9 e	22.6 e
30	13.4 e	18.6 e	20.6 f	21.9 e
32.5	2.0 b	14.3 d	6.8 c	17.0 c

Means in columns followed by the same letter do not differ with 5% of significance (Duncan's multiple range test).

The analysis of substratum taken from 10 pots with diseased plants (with base rot of leaves) confirmed the occurrence of *P. citrophthora*. On rhododendron leaf baits dark-green necrotic spots were already seen after five days of their incubation. From all spots *P. citrophthora* was detected. Studies of necrosis development on plant parts inoculated with *P. citrophthora* in relation to temperature, showed significant differences in tissue colonization of two *Saxifraga* species after three and six days of inoculation. The slowest spread of necrosis was observed at the temperature range 10–15°C whereas the quickest – at 25–30°C (Table 1).

Discussion

In the last few years the losses caused by *P. citrophthora* in *Saxifraga* crops in Poland amounted 25%.

The results obtained indicated to considerable threat to perennial crops in ornamental nurseries by *P. citrophthora*. In Polish perennial nurseries, the species was noticed as the cause of stem base rot of *Iberis sempervirens* (Orlikowski 2006) and *Lavendula angustifolia* (Ptaszek and Orlikowski unpublished). In the years 2002–2004 *P. citrophthora* was isolated from diseased stem bases and dieback tips of lilac plants growing in two container ornamental nurseries (Orlikowski and Szkuta 2005). In California, the species caused root and crown rot of *Penstemon labrosus*, but it was also isolated from surrounding soil (Brooks and Ferrin 1994). In the studies of Bush et al. (2003) *P. citrophthora* was detected in a water-recycling irrigation system in a perennial container nursery in south-western Virginia. In Poland the pathogen was also recently isolated from water ponds and drainage canals situated in ornamental nurseries (Orlikowski unpublished).

Conclusions

1. *Phytophthora citrophthora* was the most often isolated species from diseased *Saxifraga* plants and from the substratum (beside *Rhizoctonia solani* and *Botrytis cinerea*).

2. The isolate of *P. citrophthora* colonised all tested species and cultivars of *Saxifraga* already three days after inoculation. *Saxifraga arendsii* 'Rot', *S. cotyledon* 'Pyramidalis' and *S. paniculata* 'Bis' were the most sensitive to *P. citrophthora*.

3. On inoculated plants of *Saxifraga*, leaf rot developed at temperatures from 7.5 to 32.5°C, with the optimum at 25–30°C.

Streszczenie

WYSTĘPOWANIE I SZKODLIWOŚĆ *PHYTOPHTHORA CITROPHTHORA* DLA NIEKTÓRYCH GATUNKÓW I ODMIAN SKALNICY W POLSCE

Phytophthora citrophthora izolowano z większości analizowanych skalnic z objawami zgnilizny liści i podstawy pędu, jak również z podłoża spod roślin z objawami chorobowymi. W testach laboratoryjnych gatunek ten kolonizował wszystkie badane gatunki i odmiany skalnicy, przy czym nekroza rozwijała się najszybciej na *Saxifraga arendsii* 'Rot', *S. cotyledon* 'Pyramidalis' oraz *S. paniculata* 'Bis'. Uzyskane wyniki wskazują na istotne różnice w kolonizacji tkanek skalnicy przez *P. citrophthora* w temperaturze od 7,5 do 32,5°C, z optimum 25–30°C.

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Author's address:
Magdalena Ptaszek M.Sc., Research Institute of Pomology and Floriculture, ul. Pomologiczna 18, 96-100 Skierniewice, Poland, e-mail: Magdalena.Ptaszek@insad.pl

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