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New host plants for development of *Phytophthora cryptogea* in Poland

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Pathogenicity of nine isolates of *Phytophthora cryptogea* from different host plants was tested. In the laboratory trials, all cultures (except *S. arachnoideum*) colonized leaf blades and stem parts of 3 alstroemeria cultivars, but isolates from *Anthurium andreanum*, *Aquilegia discolor* and *Alstroemeria* × *hybrida* were the most pathogenic. In the tests with columbine the quickest spread of necrosis was observed on leaves inoculated with *P. cryptogea* from *A. discolor* and *Gerbera jamesonii*, whereas the slowest when isolates from *Sempervivum arachnoideum* was used. Inoculation of *S. arachnoideum* with eight isolates of *P. cryptogea* caused necrosis of leaves, but isolates from *A. discolor*, *Campanula persicifolia* and *S. arachnoideum* were the most pathogenic.

Key words: colonization, host plants, isolation, occurrence, pathogenicity, *Phytophthora cryptogea*.

Introduction. The studies of *Phytophthora* spp. conducted in Poland during the last 10 years showed the occurrence of 17 species and increasing number of new host plants for these pathogens. *Phytophthora* species were mainly observed on ericaceous and coniferous plants. *P. cinnamomi* and *P. citricola* were the casual agent of root rot and stem rot of rhododendron, heather, cypress, yew and pine plants (Orlikowski 1996, Orlikowski, Szkuta 2002b, 2003, Orlikowski et al. 2004). In the first decade of XXI century *P. cryptogea* was the most often recorded on diseased plants both in greenhouses and hardy ornamental nursery stocks. According to Erwin and Ribeiro (1996), P. cryptogea is one of the most dangerous pathogen, infected about 150 plant species belonged to 23 botanical family. In Poland the species was known for at least 40 years as the casual agent of foot rot of gerbera (Orlikowski 1967/77).

The objective of this work was to establish the occurrence of *P. cryptogea* on *Aquilegia discolor*, *Alstroemeria* × *hybrida*, *Sempervivum arachnoideum* and its pathogenicity toward 3 plant species.

Object, methods and conditions. Isolation of *Phytophthora cryptogea* from the diseased plant parts. Plants with diseased symptoms were taken in greenhouse plantations and hardy nursery stocks from June to September 2006–2008. Diseased plants or their parts were collected in plastic bags and transferred to the laboratory. The same or next day the fragments of plants were washed under tap water, rinsed in distilled water and after blotting dried and sterilized over a burner flame, 5 mm diameter pieces of tissues were put on potato-dextrose agar (Orlikowski and Szkuta, 2002). Colonies grown around inocula were transferred into PDA slants. After 7 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 PCR method with species-specific primers for *P. cryptogea* CRYF2/CRYR2 (Boersma et al., 2000).

Colonisation of plant parts by *Phytophthora cryptogea*. *Phytophthora* cultures. Isolates of *P. cryptogea* from *Anthurium andreanum*, *Aquilegia discolor*, *Alstroemeria* × *hybrida*, *Campanula persicifolia*, *Forsythia intermedia*, *Gerbera jamesonii*, *Lycopersicon esculentum*, *Saxifraga arendsii* and *Sempervivum arachnoideum* were used for inoculation of plant parts of alstroemeria, columbine and sempervivum. Stock cultures were grown on PDA at 24 °C in the dark. For plant parts inoculation five mm diameter inocula were taken from the edge of 7-day-old cultures.

Inoculation of plant parts. Leaf blades and about 8 cm long stem parts of tested plants were placed in a tray covered with moist blotting paper and plastic net. The central parts of leaves and the bases of stem pieces were inoculated with *P. cryptogea* inoculum. Trays were covered with plastic foil. After 4–5 days of incubation the size (diameter and length) of necrosis was measured. Experimental design was completely randomized with 4 replications and 10 leaf blades and stem parts in each replication. The trials were repeated at least twice.

Results. Results of laboratory trials with colonization of alstroemeria, columbine and houseleek by *P. cryptogea* from 9 different host plants showed significant differences in pathogenicity of tested isolates toward all plant species and cultivars. In trials with alstroemeria plants all isolates (except *S. arachnoideum*) colonized stem parts and leaf blades (results not shown) of three cultivars. After 4-day incubation the quickest spread of necrosis was observed on alstroemeria inoculated with culture from *A. discolor* and *A.* × *hybrida*, whereas the slowest – on stem parts treated with isolates from *S. arendsii* and *S. arachnoideum* (Table). On columbine significant differences of disease spread were especially noticed after 5-day incubation. The quickest spread of necrotic spots was observed when isolates from *G. jamesonii* and *A. discolor* were used for inoculation of leaves, whereas the slowest with culture from *S. arachnoideum* (Fig. 1).

Inoculation of *S. arachnoideum* with isolates of *P. cryptogea* from greenhouse plants as well as from field plants showed that all of them caused necrosis of leaves, but isolates from *A. discolor*, *C. persicifolia* and *S. arachnoideum* were the most pathogenic (Fig. 2).

Table. Relationship between different isolates of *Phytophthora cryptogea* and the development of necrosis on 3 cultivars of *Alstroemeria x hybrida* stem parts: length of necrosis (mm) 4 days after inoculation

Lentelė. Ryšys tarp skirtingų *Phytophthora cryptogea* izoliatų ir nekrozės vystymosi ant 3 *Alstroemeria x hybrida* veislių stiebų: nekrozės ilgis (mm), praėjus 4 dienoms po inokuliacijos

Source of P. cryptogea P. cryptogea augalas šeimininkas	Alstroemeria cultivars Alstroemeria veislės		
	'Lorena'	'Simeona'	'Tiara'
Anthurium andreanum	8.4 b	6.1 b	4.5 c
Aquilegia discolor	9.6 b	11.0 e	5.7 d
Alstroemeria × hybrida	12.5 c	8.5 d	6.2 e
Gerbera jamesonii	6.1 a	7.4 c	3.0 b
Saxifraga arendsii	6.3 a	4.4 a	3.0 b
Sempervivum arachnoideum	8.6 b	4.7 a	0 a

Note: Means followed by the same letter do not differ significantly (p = 0.05) according to Duncan's multiple range test

Pastaba: Ta pačia raide pažymėtos reikšmės pagal Dunkano kriterijų patikimai nesiskiria (p = 0,05)

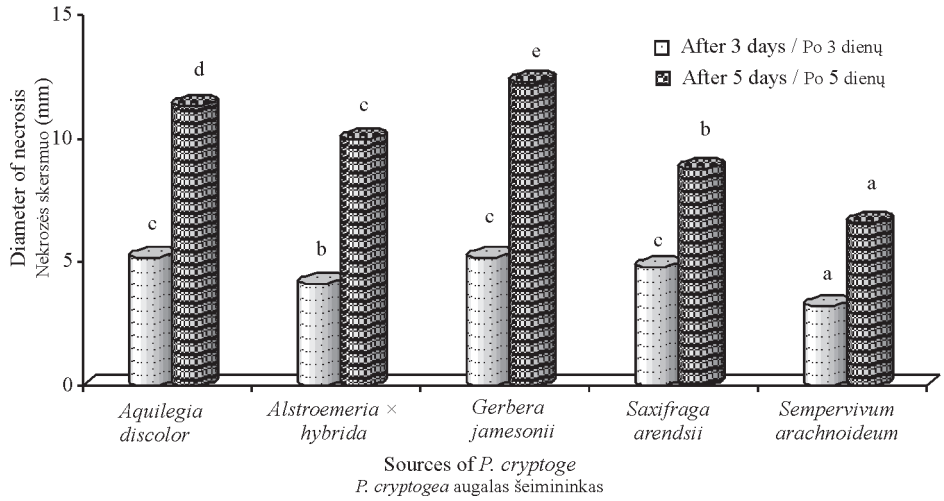

Fig. 1. Spread of necrosis on *Aquilegia discolor* leaves 3 and 5 days after plant inoculation by isolates of *P. cryptogea* from 5 different host plants. *Note*: Means followed by the same letter do not differ significantly (p = 0.05) according to Duncan's multiple range test

1 pav. Nekrozės plitimas ant *Aquilegia discolor* lapų praėjus 3 ir 5 dienoms po augalo inokuliacijos *P. cryptogea izoliatais* iš 5 skirtingų augalų. Pastaba: Ta pačia raide pažymėtos reikšmės pagal Dunkano kriterijų patikimai nesiskiria (p = 0,05)

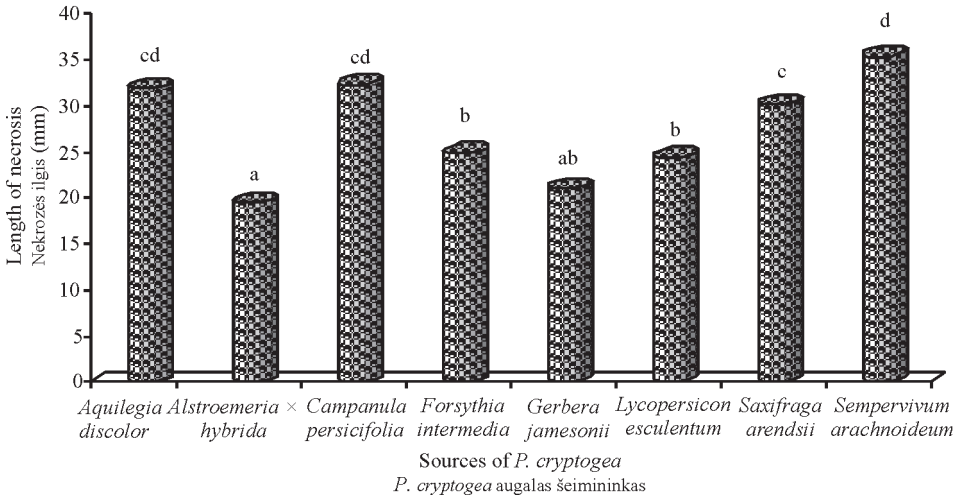

Fig. 2. Spread of necrosis on *S. arachnoideum* leaves 4 days after plant inoculation with isolates of *P. cryptogea* from 8 different host plants.
Note: Means followed by the same letter do not differ significantly (p = 0.05) according to Duncan's multiple range test
2 pav. Nekrozės plitimas ant *S. arachnoideum* lapų praėjus 4 dienoms po augalo inokuliacijos *P. cryptogea* izoliatais iš 8 skirtingų augalų.
Pastaba: Ta pačia raide pažymėtos reikšmės pagal Dunkano kriterijų patikimai nesiskiria (p = 0,05)

Discussion. During the last two years *P. cryptogea* was isolated from the most of analysed and diseased plants with stem/leaf bases and root rot symptoms. The losses caused by this pathogen, depended on species of cultivated plants and varied from 10% to even 50%.

Ours results indicated on considerable threat of *P. cryptogea* to plant crops in ornamental hardy nursery stocks as well as in greenhouses. The studies showed the lack of specialization specific for host plant and pathogen. *P. cryptogea* is not a new pathogen in Polish horticulture. The species was earlier isolated from rooted stems rot of cineraria, pachypodium and pelargonium (Orlikowski et al., 1984; Orlikowski, 1996; 2003). In the last decade of XX century *P. cryptogea* was the reason of root and stem rot of *Abies alba*, *Pinus mugho* var. *pumilo* and *P. nigra* (Orlikowski et al., 1995). In the beginning of XXI century the species was also detected from diseased *Chamaecyparis lawsoniana* (Szkuta, 2004). In the last two years *P. cryptogea* was found in perennial nurseries on *Aquilegia*, *Sempervivum* and *Saxifraga* species (Orlikowski, Ptaszek, 2007) and also was isolated from rotted stem base of *Forsythia intermedia* (Orlikowski, Ptaszek, 2008). In Germany, *P. cryptogea* was detected in water and sediments of hardy ornamental nursery reservoirs (Themann et al., 2002). The pathogen was also recovered from Polish water ponds and drainage canals situated in ornamental nurseries (Orlikowski unpbl.). It is possible that the species will spread on other plants till now not known as pathogen hosts.

Conclusions. Phytophthora cryptogea was the most often isolated species from diseased *A. discolor*, *A. x hybrida* and *S. arachnoideum* as casual agent of stem/leaf bases and root rot.

The species was isolated first time in Poland from diseased alstroemeria, forsythia and coniferous plants and some perennials including *Aquilegia Sempervivum* and *Saxifraga*.

Results of laboratory trials showed significant differences in pathogenicity of *P. cryptogea* isolates toward alstroemeria, columbine and houseleek.

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Nauji augalai *Phytophthora cryptogea* vystymuisi Lenkijoje

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Santrauka

Tirtas devynių *Phytophthora cryptogea* izoliatų iš skirtingų augalų patogeniškumas. Laboratorijos tyrimuose visos kultūros (išskyrus *S. arachnoideum*) kolonizavo 3 *Alstroemeria* veislių lapalakščius ir stiebus, tačiau patogeniškiausi buvo izoliatai iš *Anthurium andreanum*, *Aquilegia discolor* ir *Alstroemeria* × *hybrida*. Tyrimuose su sinavadais pastebėta, jog greičiausiai nekrozė plinta ant lapų, inokuliuotų su *P. cryptogea* nuo *A. discolor* ir *Gerbera jamesonii*, o lėčiausiai, kai buvo naudojami izoliatai iš *Sempervivum arachnoideum*. *S. arachnoideum* inokuliacija aštuoniais *P. cryptogea* izoliatais sukėlė lapų nekrozę, bet patogeniškiausi buvo izoliatai iš *A. discolor*, *Campanula persicifolia* ir *S. arachnoideum*.

Reikšminiai žodžiai: izoliacija, kolonizacija, paplitimas, patogeniškumas, *Phytophthora cryptogea,* užkrėsti augalai.