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FUNGI INHABITING *AMARANTHUS PANICULATUS*

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Abstract

In 2003–2005 fungal communities inhabiting phyllosphere, roots, rhizoplane and rhizosphere of symptomless ornamental foxtail amaranth (*A. paniculatus*) 'Gruner Zwerg' were investigated in Wrocław (south-west Poland). The fungi were isolated in the phase of seed formation. Phyllosphere yielded mostly *Cladosporium* spp. and *Phoma* spp. (*P. medicaginis*) and some pathogenic species (*Gibberella avenacea, Fusarium equiseti* and *F. culmorum*), few *Alternaria alternata* and *Trichoderma* spp. isolates.

In the roots, rhizoplane and rhizosphere mostly *Penicillium* spp. occurred. *Fusarium oxysporum* dominated among the genus isolates. *Cladosporium* spp. were also present together with few *Trichoderma* spp. isolates.

Key words: amaranth, fungi communities, leaves, roots

Introduction

Recently both producers and consumers are interested in new plant species named "alternative plants" or "new crops". New or newly found plant species are valuable raw material for various industry branches and also an important renewable source of energy. Additionally, the plants diversify and enrich our menu (Nalborczyk 1999).

One of those plants, origining from South America is amaranth (*Amaranthus*; Nalborczyk 1995, Piesiewicz and Ambroziak 1995, Górski 2006). The genus *Amaranthus* consists of two cultivable forms (for seed, vegetable and pasture forms), wild and ornamental. The best known form of the plant is *A. cruentus* (Nalborczyk 1995, Songin 1999). Beside the cultivable form there are also wild forms in the filed which are troublesome weed in agricultural crops. The most common weed is amaranth (*A. retroflexus*), occurring mostly in root crops and proving high resistance to herbicides applied in the crop (Rahban 1993, Michel et al. 1997). Plant lovers are eager to crop ornamental amaranth forms, in Poland

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mostly foxtail amaranth (*A. paniculatus*), with protruding deep red inflorescences (Przymęska 2004).

The aim of the work was to found what fungi communities occur in the phyllosphere, roots, rhizoplane and rhizosphere of the ornamental form *A. paniculatus* (foxtail amaranth).

Material and methods

The experiments on *A. paniculatus* were performed in 2003–2005, in allotment garden "Biskupin" in Wrocław. The gardens' area was divided into four parts, each with five places in which the amaranth 'Gruner Zwerg' plants grew in groups of 30.

To investigate the phyllosphere fungi communities five plants were taken in the phase of seed formation. From each plant three healthy symptomless leaves were taken. In the laboratory from each leaf four discs (0.5 cm^2) were cut out and placed into 20 ml Erlenmeyer flasks with 10 ml of sterile distilled water, and the flasks were shaken for 10 min in a shaker (four amplitude; 250 cycles per 1 min). Afterwards 1 ml of the water was taken and placed in a Petri dish (three replicates). Then cooled Martin-Johnson medium with tetracycline was poured into the dishes. Growing fungal colonies were transferred into PDA slants and identified.

Also isolation of fungi communities from roots, rhizoplane and rhizosphere was performed in the seed formation phase. Ten plants from each place were taken, along the diagonal of the plot. The plants were put into paper bags and transported into the laboratory in a tourist cold box. Isolation of the fungi was performed by washing the root surface as described by Mańka (1974). From every 10 plants (from one place) 1 g roots was taken and shaken for 2 min (four amplitude; 250 cycles per 1 min) in 10 following Erlenmeyer flasks with 70 cm^3 of sterile water each. In the ninth flask the water contained 30 g of sterile quartz sand, to remove from the root surface fungi that were not grown into the root. After the procedure the roots were taken out and dried in sterile filter paper, cut into 5-mm-long inocula and placed onto PDA medium in Petri dishes (six inocula per dish). That was isolation of fungi connected with inner root tissues.

To isolate fungi from the rhizosphere (flask II and IV) and rhizoplane (flask IX) 1 ml of water suspension was taken and evenly distributed on the Martin-Johnson medium in a Petri dish. Growing fungal colonies were transferred into PDA slants and identified.

Results

From *A. paniculatus* phyllosphere 26 species were obtained (Table 1). Beside *Cladosporium* spp., the most often isolated species were *Phoma* spp. (mainly *P. medicaginis*). On foxtail amaranth mostly *C. cladosporioides* was found. Also pathogenic *Fusarium* spp. (*Gibberella avenacea*, *F. equiseti* and *F. culmorum*) were isolated

Table 1

Fungi inhabiting *Amaranthus paniculatus* in 2003–2005 (number of isolates)

Fungus	Phyllosphere			Roots			Rhizosphere and rhizoplane								
							2003			2004			2005		
	2003	2004	2005	2003	2004	2005	flask's number			flask's number			flask's number		
							II	IV	IX	II	IV	IX	II	IV	IX
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Alternaria alternata	23	33	23	1		1	2			1	1		1		
Arthrinium pheospermum	12	23	27	1	1	3									2
Aspergillus niger							1			1			1	1	
Cladosporium cladosporioides	34	55	68	4		9	7			10		12	12	11	12
Cladosporium herbarum		1					3			5			5		
Coleophoma empetri	22	16	18												2
Epicoccum purpurascens	1	7	12												
Fusarium avenaceum	1	2	4	1	1	1	1			2			2		
Fusarium culmorum	3	6	8												
Fusarium dimerum			2												
Fusarium equiseti	2	9	3				2			1			1		
Fusarium graminearum			4												
Fusarium oxysporum				8	13	3									
Fusarium poae							9			5			5		2
Fusarium sambucinum	2		11												
Fusarium sporotrichioides	1		1				1			1			1		
Geotrichum candidum	1	1	2												
Gonatobotryum fuscum														2	1
Humicola grisea															1
Mucor hiemalis				5	6	7	1			1			1		

Table 1 – cont.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Penicillium claviforme				1	1	4	1			1		1	1		2
Penicillium commune	1		1												
Penicillium luteum	1	1		1	1	4						2			2
Penicillium notatum			5	34	42	46					1			1	
Penicillium purpurogenum	2	12	23	1	1	1					1			1	2
Penicillium thomii			2	3	6	7	13	12	9	35	34	38	48	37	35
Penicillium velutinum	4	1	3	7	12	11									
Penicillium expansum	3	8	13					2			2	3		4	5
Periconia minutissima							21	17	9	31	12	18	37	23	18
Phoma eupyrena	1	2													
Phoma exigua															
Phoma fimeti			2												
Phoma herbarum															
Phoma leveillei	1		2												
Phoma medicaginis	45	56	78			7									12
Pleospora herbarum															
Stachybotrys atra				1		2									
Tetracoccosporium paxianum						1	1			1			1		
Trichoderma hamatum	22	13	11												
Yeast colonies							1			1			1		
Dark non-sporulating colonies			12				1				12	1			1
Grey non-sporulating colonies			11			2	5								
Total	182	246	346	68	84	109	70	31	18	96	63	75	117	80	97

from leaves. A small number of *Alternaria alternata* and *Trichoderma* spp. isolates were also obtained.

From *A. paniculatus* roots 13 species of fungi were isolated (Table 1), with the greatest share of *Penicillium* spp. The dominating *Fusarium* species was *F. oxysporum*. The *Penicillium* genus was represented mainly by *P. notatum* and *P. velutinum*, with the former dominating in roots of the ornamental cultivar in question. Beside the above mentioned species also *A. alternata*, *Phoma* spp. and *Cladosporium* spp. were isolated.

From rhizoplane and rhizosphere 23 species were isolated (Table 1). The rhizosphere yielded always more species than the rhizoplane. In both rhizoplane and rhizosphere of *A. paniculatus* dominated *Penicillium* spp. The genus was represented mainly by *P. velutinum*, *P. thomii* and *P. expansum*. *Cladosporium* spp. were also numerous (mainly *C. cladosporioides* and *C. herbarum*). Also *Periconia minutissima* was abundant in rhizoplane and rhizosphere of all investigated amaranth species. *Fusarium* spp. were also obtained. Every year in the fungal communities in question few *Trichoderma* spp. and *Phoma* spp. were present. There were also some yeasts in the rhizosphere of *A. paniculatus*.

Discussion

In the phyllosphere fungi communities the most common species were *Cladosporium* spp. (*C. cladosporioides* and *C. herbarum*) and *A. alternata*. Kita (1988), Kutrzeba (1993) and Chmiel (1995) confirm that the fungi are common on the leaf surface on plant species. On ornamental amaranth *C. cladosporioides* was almost the only species.

From roots, rhizosphere and rhizoplane of foxtail amaranth numerous fungi of genera *Penicillium*, *Fusarium*, *Cladosporium*, *Phoma* and *A. alternata* were isolated. According to Warcup (1971) the species are common in various cultivated plant's environment. Some of them, like *Fusarium* spp. can cause root rot of the cultivated amaranth (Chen and Swart 2001, Blodgett et al. 2004). Despite their presence in the roots, there were no symptoms of rot in the work described here. The most numerous species was *F. oxysporum* which is a saprotroph common in the soil environment (Garret 1970). Under favourable conditions it may turn a severe pathogen, with numerous *formae speciales* affecting many plant species (Nelson et al. 1981). Most probably the good health status of the roots in question was due to the antagonistic organisms (Dorenda 1982, Weller 1988, Benhamou et al. 2002), including *Trichoderma* spp. which grow very fast and have the ability to produce big amounts of antibiotics (Salina 1981, Kredics et al. 2003, Kucik and Kivanc 2003, Clarkson et al. 2004). The non-pathogenic strains of *Fusarium* spp. are of importance too, including *F. oxysporum* (Benhamou et al. 2002). Most probably that was the situation in the case studied.

From rhizosphere and rhizoplane of *A. paniculatus* numerous *Penicillium* spp. were isolated which occur often in soils reach in nutrients (Maciejowska-Pokacka 1971). In rhizosphere and rhizoplane there were also numerous *Cladosporium* spp.,

which similarly to *A. alternata*, colonize usually old and senescing tissues, which results in their big share in the number of isolates obtained. The results are in agreement with the results of authors working on fungal communities of other crops (Dorenda 1982, Wagner 1983, Majchrzak 1985, Mazur 1992, Mazur et al. 1992, Pląskowska 1996). Most of the species isolated from cultivated amaranth environment are considered fungi occurring commonly in cultivated soil environment (Henis et al. 1979, Truszkowska et al. 1979).

Conclusions

1. Fungi species connected with various organs of *Amaranthus paniculatus* do not differ from those connected with other cultivated plant species.
2. *Amaranthus paniculatus* did not display any disease symptoms while under investigation. This can be connected with the effect of the plant fungal community on possible pathogens.

Streszczenie

GRZYBY ZASIEDLAJĄCE *AMARANTHUS PANICULATUS*

W latach 2003–2005 badano zbiorowiska grzybów związanych z fyllosferą oraz korzeniami, ryzoplaną i ryzosferą ozdobnej formy szarłatu wiechowatego (*Amaranthus paniculatus*) 'Gruner Zwerg' uprawianego na terenie Pracowniczych Ogródków Działkowych „Biskupin" we Wrocławiu. Zbiorowiska grzybów określano w fazie zawiązywania nasion.

Z fyllosfery *A. paniculatus* wyosobniono łącznie 26 gatunków, najczęściej otrzymując *Cladosporium* spp. i *Phoma* spp. (głównie *P. medicaginis*). Wystąpiły także grzyby patogeniczne rodzaju *Fusarium* (*Gibberella avenacea, F. equiseti* i *F. culmorum*), niewielka liczba izolatów *Alternaria alternata* oraz *Trichoderma* spp.

Z korzeni *A. paniculatus* wyizolowano łącznie 13 gatunków grzybów, z największym udziałem rodzaju *Penicillium*. Wśród *Fusarium* spp. dominował *F. oxysporum*. Rodzaj *Penicillium* był reprezentowany głównie przez dwa gatunki: *P. notatum* i *P. velutinum*. Oprócz wymienionych gatunków nielicznie izolowano również: *A. alternata, Phoma* spp. i *Cladosporium* spp.

Ze strefy przykorzeniowej wyosobniono 23 gatunki grzybów (bogatszy skład gatunkowy uzyskiwano zawsze z ryzosfery niż z ryzoplany). W ryzosferze i ryzoplanie dominowały grzyby rodzaju *Penicillium* (głównie *P. velutinum, P. thomii* i *P. expansum*). Dość licznie były izolowane *Cladosporium* spp. (*C. cladosporioides* i *C. herbarum*) oraz *Periconia minutissima*. Otrzymano również grzyby rodzaju *Fusarium*. Corocznie w opisywanych zbiorowiskach, w niewielkiej liczbie, występowały *Trichoderma* spp. oraz *Phoma* spp. Z ryzosferą *A. paniculatus* były związane również grzyby drożdżoidalne.

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