Poznań University of Life Sciences, Poznań, Poland

FUNGI INHABITING *FAGUS SYLVATICA* SEEDS AFTER HARVEST AND AFTER DRYING

M. Mańka, P. Łakomy, R. Cieślak and A. Szynkiewicz

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European beech (*Fagus sylvatica*) is an important broadleaved species in Polish forests. Production of beech seedlings and transplants for establishing new stands depends on available seed material, produced by trees in good seed crop-years, which occur rather rarely – every 10 or more years (Buk zwyczajny *Fagus sylvatica* L. 1990). That is why beech seeds must be stored for several years and the procedure of drying them before storage is common.

The aim of the work was to recognize fungi communities inhabiting European beech seeds.

Phytopathological analysis of beech seeds was performed in 2005 in the Department of Forest Pathology of the August Cieszkowski Agricultural University (now: Poznań University of Life Sciences). Two lots were taken into consideration: seeds just after harvest and dried seeds.

For isolation of fungi from the seed surface and from the inner part of seeds' 150 seeds of each lot were taken at random. Before isolation of fungi from the seed surface the seeds were washed with tap water and dried in sterile blotting paper.

For isolation of fungi from the inside part of seed, after washing the seeds with tap water they were surface sterilized with 3% sodium hypochlorite for 3 min, then rinsed in sterile distilled water three times for 10 min and finally dried in sterile blotting paper. The seeds were deprived of seed cover, cut and placed on sterile media. At cutting, attention was paid to discolorations and necroses of cotyledons and germ tubes. Two media were applied: PDA (PDA Difco with streptomycin sulphate [0.1 g/l]) and synthetic medium SNA (glucose 0.2 g; sacharose 0.2 g; KH_2PO_4 1 g; KNO_3 1 g; $MgSO_4 \times 7H_2O$ 0.5 g; KCl 0.5 g; agar 15 g; streptomycin sulphate 0.1 g; distilled water 1 l).

The fungal colonies obtained were transferred first to PDA slants and then – for identification – to SNA, PDA, 4% malt agar or Czapek-Dox medium. The cultures were identified with keys by Domsch et al. (1980), Ellis and Ellis (1987), Kwaśna et al. (1991) and Sutton (1980).

Circa 10% of beech seeds displayed, whet cut, tiny single brown discolorations (diameter 2–5 mm) of cotyledons, while another 10% of beech seeds were totally

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brown and 3% – black. In single cotyledons the spots were bigger, reaching diameter of 1 cm.

The communities of fungi isolated from the seed surface were small, both from seeds after harvest (73 isolates) and from those dried (163 isolates), with only few species considered pathogenic in each lot (Tables 1–4). Altogether the beech seeds examined were inhabited by 52 species of fungi. The results of fungi isolation from beech seeds are presented in Tables 1–4.

The most often occurring and most severe pathogens found inside beech seeds analysed after harvest were *Fusarium* spp. (9.7%) and *Phomopsis* sp. 1 (5.47%).

The most often occurring and most severe pathogens found in beech seeds analysed after drying were *Fusicoccum* sp. (9.71%), *Cylindrocarpon* spp. (3.6%) and *Fusarium semitectum* (2.52%).

In the communities of fungi from inside the seeds following species/genera known as pathogenic occurred:

1) in seeds after harvest (402 isolates altogether): *Cylindrocarpon magnusianum* (1%), *Fusarium avenaceum* (5%), *F. oxysporum* (1.5%), *F. sambucinum* (2.7%), *F. sporotrichioides* (0.5%), *Mucor racemosus* (1.2%), *Phomopsis* sp. (5.5%) and *Sclerotinia sclerotiorum* (0.2%),

2) in dried seeds (278 isolates altogether): *Cylindrocarpon destructans* (2.5%), *C. magnusianum* (1%), *F. semitectum* (2.5%), *Fusicoccum* sp. (9.7%) and *M. racemosus* (1.4%).

In both lots of beech seeds the pathogenic fungi consisted ca 17% of the community.

It seems that drying seeds may have contributed to the increase of isolates' number on the surface of seeds and to reduction of the number inside seeds. In both lots of seeds the share of pathogenic species was similar and the species may be divided into two categories: damping-off pathogens (*Alternaria* spp., *Cylindrocarpon* spp., *Fusarium* spp.) and seed damaging (rotting) pathogens (*Sclerotinia sclerotiorum, M. racemosus, Fusicoccum* sp.).

Table 1

Fungi* obtained from the surface of beech seeds examined just after harvest

Species	Number of isolates	Frequency (%)
Alternaria alternata	1	1.37
Fusarium sambucinum	1	1.37
Penicillium janczewskii	2	2.74
Trichoderma aureoviride	11	15.07
Trichoderma hamatum	10	13.7
Trichoderma koningii	43	58.9
Trichoderma longibrachiatum	5	6.85
Total	73	100

*Names of pathogenic fungi are in bold characters.

Table 2

Fungi* obtained from inside of beech seeds examined just after harvest

Species	Number of isolates	Frequency (%)
Acremonium kiliense	6	1.49
Acremonium strictum	7	1.74
Alternaria alternata	28	6.97
Alternaria tenuissima	26	6.47
Coleophoma sp.	3	0.75
Cylindrocarpon magnusianum	4	1
Discosia atrocreas	1	0.25
Epicoccum purpurascens	63	15.67
Fusarium avenaceum	20	4.98
Fusarium oxysporum	6	1.49
Fusarium sambucinum	11	2.74
Fusarium sporotrichioides	2	0.49
Macrophoma sp.	3	0.75
Mortierella isabellina	1	0.25
Mortierella ramanniana var. *ramanniana*	9	2.24
Mortierella vinacea	4	1
Mucor racemosus	5	1.24
Penicillium brevicompactum	2	0.49
Penicillium citrinum	2	0.49
Penicillium janczewskii	14	3.48
Penicillium luteum	1	0.25
Penicillium steckii	2	0.49
Phoma eupyrena	2	0.49
Phoma sp. 1	4	1
***Phomopsis* sp. 1**	22	5.47
Phragmotrichum rivoclarinum	3	0.75
Sclerotinia sclerotiorum	1	0.25
Sphaeriales sp. 1	1	0.25
Trichoderma aureoviride	12	2.99
Trichoderma hamatum	14	3.48
Trichoderma harzianum	28	6.97
Trichoderma koningii	17	4.23
Trichoderma longibrachiatum	4	1
Trichoderma viride	31	7.96
Trichothecium roseum	3	0.75
Truncatella truncata	2	0.49
Non sporulating sp. 1	13	3.23
Non sporulating sp. 2	19	4.72
Non sporulating sp. 3	3	0.75
Non sporulating sp. 4	2	0.49
Total	402	100

*See Table 1.

Table 3

Fungi* obtained from the surface of beech seeds examined after drying

Species	Number of isolates	Frequency (%)
Alternaria tenuissima	1	0.61
Mucor hiemalis	131	80.37
Mucor racemosus	14	8.59
Penicillium citrinum	1	0.61
Penicillium cyclopium	1	0.61
Non sporulating sp. 5	15	9.21
Total	163	100

*See Table 1.

Table 4

Fungi* obtained from inside of beech seeds examined after drying

Species	Number of isolates	Frequency (%)
1	2	3
Acremonium strictum	7	2.51
Alternaria alternata	1	0.36
Alternaria tenuissima	53	19.06
Arthrobotrys arthrobotryoides	12	4.32
Camerosporium sp.	3	1.08
Cladosporium herbarum	41	14.75
Coniothyrium sp.	5	1.79
Cylindrocarpon destructans	7	2.52
Cylindrocarpon magnusianum	3	1.08
Epicoccum purpurascens	4	1.44
Fusarium semitectum	7	2.52
***Fusicoccum* sp.**	27	9.71
Humicola grisea	6	2.16
Mucor hiemalis	1	0.36
Mucor racemosus	4	1.44
Penicillium brevicompactum	9	3.24
Penicillium cyclopium	1	0.36
Penicillium janczewskii	4	1.44
Penicillium stoloniferum	2	0.72
Phoma sp. 1	2	0.72
Trichoderma hamatum	4	1.44
Non sporulating sp. 1	16	5.76
Non sporulating sp. 2	5	1.79
Non sporulating sp. 3	4	1.44

Table 4 – cont.

1	2	3
Non sporulating sp. 4	8	2.88
Non sporulating sp. 6	31	11.15
Non sporulating sp. 7	3	1.08
Non sporulating sp. 8	2	0.72
Non sporulating sp. 9	6	2.16
Total	278	100

*See Table 1.

It is worth mentioning that the considerable share of *Trichoderma* spp. in the communities from seeds after harvest – 94.5% on the surface and 26.63% inside seeds – decreased dramatically after drying – 0% and 1.44%, respectively.

On the surface of beech seeds only two species of pathogenic fungi were found: *Fusarium sambucinum* (1.37%) in seeds analysed after harvest and *Mucor racemosus* (8.59%) in seeds analysed after drying.

Vast majority of the fungi obtained were saprotrophic fungi colonizing tissues immediately after their dieback, or week pathogens colonizing dying tissue.

Mucor racemosus, *Penicillium* spp. and other fungi obtained, which can be considered storage fungi, produce great number of abundant colonies developing on numerous organic and inorganic substrates/media. The colonies produce immense numbers of spores, that start new colonies in big amounts. The spores are easily wind borne and they stay in the air for some time. They can colonize plaster, wood, synthetic materials and most of all – every small part of organic substrate, thus being a constant source of infection for seed lots in storage.

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Authors' address:
Prof. Dr. hab. Małgorzata Mańka, Prof. Dr. hab. Piotr Łakomy, Dr. Radosław Cieślak, Anna Szynkiewicz M.Sc., Department of Forest Pathology, Poznań University of Life Sciences, ul. Wojska Polskiego 71 C, 60-625 Poznań, Poland, e-mail: mmanka@up.poznan.pl

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