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# Pathogens of forrest trees in nurseries –a minireview

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## ABSTRACT

The forest trees nurseries are attacked by different pathogens which are causing important damages and economic loss in forest commercial exploitations. One of the most important losses are in the tree nurseries, damaging the trees in their first stages of life Main pathogens for roots and stems are shown in this work. The fungi described may atack many agricultural cultures, and only some of them are specific for forest trees. The economic damages can be semnificatives. Some solutions for prevention and treatment of fungal pathogens attack are discussed further.

**Key words:** *forest nurseries; soil fungal pathogens; roots and stem pathogens.*

## Indexing terms/Keywords

Forrest trees nurseries; fungal pathogens; root pathogens.

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## INTRODUCTION

Many species and genera of pathogenic fungi attacking seedlings in forest nurseries are frequent founded in all the world. For example, in Finland, Arja Lilja (2010) identified in green houses species of *Fusarium sp., Rhizoctonia* sp., *Mycrosphaerella tulasnei* and in nurseries: *Schyzophyllum commune, Sclerotinia pseudotuberosa, Alternaria* sp., *Rhizopus. nigricans, Diaporthe insularis, Mucor nigricans, Taphrina coerulescens*, *Melanospora populis* (Taut et al, 2006) frequent not only in trees but in many other plants cultures.The treatment was made with fungicides as Alert, Bumper, Folpan, Systhane, Previcur, Karathane in the recommended doses for this kind of cultures. In Canada there are about 144 nurseries producing mainly seedlings in plastic boxes and the common pathogens are *Botrytis cinerea* Pers, *Fusarium sp.*, *Sirococcus strobilinus* Preuss. At the ground and root level there are species of *Pythium, Phytophthora, Fusarium, Rhizoctonia* and others which are present in other geographical areas too (Sutherland et al 2010). The disease of the stem rot is produced by some fungi like *Fusarium, Pythium, Botrytis, Rhizoctonia* and *Alternaria.* the rot of seedlings is produced by fungi from *Roselinia* and *Phytophtora*, genera and the seedlings damping is produced by the fungi *Theleophora terestris* (Vanin 1957). Borja et Austara (1990) showed that the production of forest trees seedlings in containers is attacked by *Lophodermium seditiosum, Sirococcus strobilinus, Gremmeniella abietina, Melampsora pinitorqua* and *Phacidium*. In Romania, in forest nurseries from Suceava, the pathogens (18.59%) are root pathogens like *Fusarium oxysporum, Pythium debaryanum, Rhizoctonia* sp, *Alternari*a, Phytophora; stem, sprout and branch pathogens*: Botrytis cinerea*; and the leaves: *Microsphaera abbreviate, Rhythysma*, *Lophodermium* sp., *Cocomyces hiemalis*, *Guignardia* spp. (Grădinariu et al, 2012). In Romania some main pathogens occurs. We can mention leafs and branches pathogen *Lophodermium pinastri Rosellinia byssede* (on coniferous trees), *Erysiphe alphytoides* and *Phytophtora cactorum* and the ubiquist *Fusarium oxysporum* (Pârvu 2000). There are some main fungi that are producing root disease in nurseries, *Cylindrocarpon* Wallew., *Fusarium* Lurk. Fr., *Phytophtora* de Barry and *Pythium* Hesse that are most frequent found in cultures, in some barefoot nurseries and in protected growth environment too in containers cultivation. Some of them are related with high soil humidity content and low aeration and can be transmitted by soil, water irrigation and equipment (containers and others) (Dumroese et James 2014). They affect mainly coniferous species, the most sensible being the Douglas fir tree, producing damping-off and decay.n the next pages we shortly present some of the main fugal pathogens.

## MAIN FUNGAL PATHOGENS IN THE FOREST TREES NURSERIES

***Pythium debaryanum*** Hesse (cls Oomycetes, ord Pythiales, fam Pythiaceae) is a fungal pathogen attacking the seedlings and the early stages of development of the tomatoes and other legumes and many shrub and trees after germination and is wide spreaded in agricultural plant cultivation in greenhouses and fields included the forest trees nurseries producing the so called dampfing-off. This is a fungus with ramified (branched mycelia, with unicellular hyphae producing zoospores in zoosporangia. The conidial form are spherical spores of 22-25um (Adelaide university site). The zoosporangia appears in high humidity conditions (Rădulescu and Rafailă 1970) in host tissues and the seeds becomes brownish and brownish necrotic tissue appears at the base of the young stems. Following this attack the stem rotten and the plants fall to the ground, being very frequent in many cultures of legumes, industrial plants, trees and forest nurseries, seedlings and many others. The fungus was founded to attack the seedlings of *Betula* sp. (Lilja et al 2010). In Canada was found another species from this genus, *Pythium sylvaticum* W.A. Campb. & F.F. Hendrix 1967 (Vaartaja, 1975).

***Fusarium oxysporum*** Schlecht (fam. *Nectriaceae*, ord. *Hypocreales*) toghether with other fungi from genera *Pythium, Phytophthora, Rhizoctonia, Phomopsis, Alternaria*, *Botrytis*, produce the plants mortality in the period from germnation to the lignification of young stems, producing important damages to the forest trees species in nurseries and protected cultures and different plants species in the cultivated agricultural field . The pathogen has many specialized forms to every plant species (ex *F oxysporum* f.sp *lycopersici* (tomate*), F. oxysporum* f sp. *pini*, *F. oxysporum* f.sp. *querci*, etc. *Fusarium oxysporum var aurantiacum).Fusarium oxysporum* growth and sporulate on different culture media (potato-dextrose-agar, malt extract-agar, Czapek-agar etc.) and its growing optimal temperature is 25-30 ºC. The mycelia is formed from hyphae septatae, branched with conidiophores with conidia and chlamidospores. They have microconidia uni, bi and tricellular. Cylindrical or oval (5-12 x 2,2–3,5 µm), and macroconidia in fusiform shape curved and pluricellular (27-46 x 3-4,5 µm) with 3 (5) transversal septae. The chlamidospores unicellular, hyalins (5-15 µm diameter), smooth or rough surface, disposed in chains or single, terminally or intercallar (Pârvu, 2000). The fungi survive through conidia, chlamidospores and resistance mycelia from plants and plants debris. The disease is favourized by the humidity from soils and deposits and by temperature (10-35°C). The mycelia hyphae are hyaline or coloured in pale rose, they attack the plants which can fall after their emergence from soils.In United States attacks with *Fusarium commune* to forest trees nurseries to coniferous trees like Douglas fire trees (*Pseudotsuga menziesii)*, pines (*Pinus ponderosa*) and others(Kim et al 2011). The plantlets are covered with a white mycelia, the leaves getting yellow and dryed, the fungi forms a white mould surrounding the stem near the ground level. The critical period of time is between sowing and 50 days of development. Other pathogenic fungi attacking in nurseries are *F. blasticola* Rostr., Gartner-Tidende*, F. moniliforme Sheldon, F. ventricosum* (Sacc.) Nirenberg *Giberrella fujikuroi* (Sawada) Wollenw.*, F. sporotrichoides* Sherb..

***Rhizoctonia*** Kuhn **(** Class *Agaricomycetes* Ord. *Cantharellales* Fam. *Ceratobasidiaceae*)

The mycelia is like a fabric of brown –violett colour hyphae; the plant tissue becomes grey and all the root became rotten. The fungi attack about 200 species of cultivated plants including forest trees species (Baicu si Sesan 1996). Normally is a saprofite and an opportunistic pathogen in some conditions in the starting period of the vegetation (Radulescu and Rafaila 1970). Its forms sclerotia which can resist about 7-8 years. On roots appear many very branched hyphae. They are saprophytic but opportunistic pathogens.

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Species *R solani* Kuhn, *R bataticola*, *R. carotae* and so on, attacking legume plants, umbelliferous plants and others rice, maize, potato and others. Humidity and a temperature of about 12-30°C favor the growth (Moorman, 2014). The fungus was demonstated to attack the seedlings and *Pinus, Picea, Larix, Eucalyptus, Ulmus*. Other species *R endophytica* va *endophytica* Saks. and *R repens* Bernard attack too some species of trees.

***Alternaria spp.*** *(Ascomycota Class: Dothideomycetes Subclass: Pleosporomycetidae Order: Pleosporales Family: Pleosporaceae)*

## *Alternaria alternata* (Fr.) Keissl.

The mycelia of this fungi develops intra cellular and forms single or in form of a row of black color with olive colored bottle shaped conidia disposed in chains. The plantlets fall occurs to the 1-month old plantlets following yellowing of the plants and root rot (Vanin 1957).

***Rosellinia spp.*** (*Ascomycota* Class: *Sordariomycetes* Order: *Xylariale*s Family: *Xylariaceae* Genus: *Rosellinia* De Not.

*Rosellinia necatrix* Berl. ex Prill., is a pathogen of trees in nurseries attacking both softwood and hardwood species including orchard fruit trees species (Carlucci et al 2013)

*Rosellinia quercina* R Hartig (fam. Xylariaceae, ord. Xylariales) produce the root rot of young trees in nurseries. This disease is dangerous for the oak plantlets (*Quercus robur*), of about 1-3 years old and are less frequent to the 10 month old plantlets. This fungus attack the plantlets of beech (*Fagus sylvatica),* spruce (*Picea excelsa*) and maple (*Platanus* sp). The mycelia are rhizomorphs founded under bark and wood at the ground levels in stem and in roots developing conidiophores with ovoid or cylindrical conidia. The perithecia are about 1 mm diameter, carbon-black containing cylindrical ascae with 8 fusiforms unicellular brownish ascospores. They have resistance formations (sclerots). The infection take place in nurseries in excessive humidity conditions in forest nurseries , the plantlets having progressive discoloration. The control is done by removing the contaminated plantlets, their burn and use of Topsin M 700 in concentration of 10% (Pârvu, 2000). The *Rosellinia* species attack too the forest and fruit trees from Mediterranean area the attack being influenced by soil structure and type (Carlucci et al, 2013). In the Mediterranean area *R necatrix* was identified like pathogen of the fig tree (Papachatzis et al, 2008).

***Verticillium*** Ascomycota (Anamorphic Hypocreales) Class: Incertae sedis Family: Plectosphaerellaceae Genus: Verticillium Nees )

*Verticillium tenerum* Nees, *Verticillium dahliae* Kleb. *Verticillium albo-atrum* Reinke & Berthold are a pathogens and can resist as saprophytes too. The last can infect many woody species maples, elms, aspen, ash, beech and others. The member of the genus can attack over 300 plant species with a large spreding in the world the propagules being resistant several years in soils at relative low temperature, and being transported from a place to the other by wind, agricultural machinery and equipment. They release toxins producing the narrowing of transport vessels and finally the plant death, following a low level flux of nutrients, and other symptoms (yellowing of leaves, leaves fall and wood discoloration).

***Phytophtora*** *(Eukaryota Phylum: Heterokontophyta Class: OomycetesOrder: Peronosporales Family: Pythiaceae Genus: Phytophthora).*

The genus have many species, but important are the *Phytophthora cactorum (Lebert & Cohn) J. Schröt., Phytophthora cinnamomi* Rand.), *Phytophthora ramorum* Werres et al. 2001 *Phytophthora quercina* T. Jung and T.I. Burgess, 2009 are pathogens of the forest trees too. The fungus produce the decay of plants roots. They attack the pine and fire trees Douglas plantlets in nurseries. Other species producing the decay of these trees in nurseries are several species of *Phytophtora*-roots decay. The and became black inside. They produce roots decays in many countries including Romania.

***Phytophthora cinnamomi*** **(**Rand.) produce the decay of the roots of pine seedlings (Brown and Wylie, 1990).This fungi produce the decline of a large number of species of trees and ornamental plants in all the world and produced epidemics for example fire blight of chestnuts and the decline of oak trees *Quercus suber* and *Q ilex* (Sanchez et al, 2002).

***Phytophthora cactorum*** (Lebert & Cohn) J. Schröt.

This is a typical pathogen of softwood and hardwood plantlets, the plantlets infected have symptoms at the level of both over and under ground organs even in the first phases of germination at the insertion of cotyledons resulting in the color change in browning of the fine roots and extended to the fresh germinated seeds and embrios.

The pathogen *Phytophthora cactorum* (fam. *Peronosporaceae*, ord. *Peronosporales*) this has an endoparasitic mycelium represented by siphonoplast forming sexual organs elements (anteridia and oogons) and sporangiophores with sporangia. The fungus produce economical damages in nusrseries damaging the plantlets at soil levl and distroying even the cotiledons and the embrio the mycelia growth inter cellular (Georgescu et al ,1957).The oospores resulting from the sexual process are spherical form resistance organs of yellow brownish color and resist over winter season. By sporanges germinations results biflagelled zoospores or infection filaments (Parvu, 2000). Acording to the same author, the prevention s performed with treatment of the seeds with insecto fungicides and the cure treatment with contact (Captan 50PU 0,125%) and systemic fungicides (Ridomil MZ 72 WP 0,25% sau Aliette C 0,25% ).

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*Phytophthora kernoviae* sp. nov., an invasive pathogen causing bleeding stem lesions on forest trees and foliar necrosis of ornamentals in the UK (Brassier et al 2005).

***Phytophtora omnivora*** LC Coleman (syn *P. palmivora, P. fagi*).

Produce the decay of the plantlets and appears not so frequent and produce the root and aerian plant parts rot. Is a fungus producing less branched conidiophores with lemon shape conidia. The oospores are brown smooth membrane. Its produce spots on collar roots and young stems followed by apparition of a whitish mycelium. Other species is the *P. plurivora*. (Jung et Burgess, 2009). The oospores remains in plant material for overwintering, restarting the infection in spring.

***Botrytis cinerea*** (De Bary) Whetzel **(***Ascomycota,: Pezizomycotina Class: Leotiomycetes Order: Helotiales Family: Sclerotiniaceae)*

The greymold is affecting a major part of the cultivated plants and in the same time the forest woody species in special in bareroot nurseries, affecting the seedlings. It has a wide domain of growing temperature from 0 to 25 C, optimal growth and conidia formation occurs at 20-22C (Russel, 1990) and the spores can germinate at 0-5°C. The lack of aeration and packaging in bags can increase the risks of damage by grey mold attack.

***Armillaria spp***

Contains several fungal pathogen from *Basidiomycetes,* from family *Agaricales* attacking the root of forest species all over the world leading to their decay. One of the most common is *Armillaria mellea* (Vahl) P.Kumm. They develop yellow honey like fructifications and forms rhizomorphs and some of them do not caused frequently the trees death, but, they determinate the reduction of terminal growth and reduction of tree fruit production and chlorosis of leaves. *Armillaria* is attacking Mediterranean woody plants like *Ficus carica* (Papachatzis et al., 2008).

***Thelephora terrestris*** Ehrenh.

Is a fungus belonging to the *Basidiomycetes*, Order *Hymenomycetales* Fam *Thelephoraceae*, contains about 50 species. The basidiocarp is leather like, with shell lile form brownish color and hymenophores with roundish brown basidiospores.The fungus attack the plantlets of softwood species and the hardwood too and in humid years even the branches and ternminal buds (Vanin 1957). Other species is *Telephora laciniata* Pers. Which are attacking the spruce (Georgescu et al 1957).

***Cylindrocarpon destructans*** *(Zins.) Scholten (Phylum: Ascomycota Class: Sordariomycetes Subclass: Hypocreomycetidae Order: Hypocreales Family: Nectriaceae Genus: Cylindrocarpon Wollenw. 1913)*

Is wide spreaded in the wood soils and is associated with many woody plants producing a root rot them, including grapevine producing black foot disease and decline in young grapevine (Petit et al, 2005). In forest nurseries they attack the species of pine and Douglas fir tree (Hamm et al 2005).

## MECHANISMS OF CONTAMINATION

Moorman (2014) comment on his site the sources of pathogens in forest trees nurseries. It is obvious that a important source is the infested soils for example the fungi *Cylindrocladium, Pythium, Phytophthora, Fusarium, Rhizoctonia*, and *Thielaviopsis*, from nursery soils or soil mix potting mix for cultivation boxes and containers. Practically the soil is one of the way of contamination and sometimes is a propagation medium for plant pathogens. Spores and mycelia of some fungi can resist and be propagates by using contaminated soils or substrates like bog, sands and peats. Other source can be the plant debris leaves, stems, root, branches (*Phytophthora, Thielaviopsis, Rhizoctonia, Cylindrocladium, Phomopsis, Botryosphaeria, Sphaeropsis, Verticillium, Cytospora, and Nectria)*, living plants or by different weeds hosts for pathogens or enter in the nurseries with irrigation water (*Phytophtora, Pythium*) or air currents (spores, powdery mildew, rusts). Other source is the clothes, shoes and working equipment of the personnel from nurseries .

## PREVENTION AND TREATMENT

The specialists recommend to be careful with the selection of initial plant material, to filtration of water for irrigations and to disinfection of substrate and personnel hygiene in order to avoid contaminations. The prevention of pathogen dispersal is important to avoid contaminations problems (Desprez-Loustau et al, 2006). Using chemicals for disinfection of plant material is a standard for decontamination of water for irrigation with chlorine compounds (Machado et al 2013). Other strategies are the removal of pathogen from surfaces, use of solarization of the soils, fumigation with chemicals or steam pasteurization of soils, roots, stems and seeds, or/and preventive treatment with fungicides.There are some treatrment with, 100% methyl bromide (MB), 100% chloropicrin (CP), “combinations of both, and dazomet (Enebak et al, 1990). Some authors recommend expensive methods of genetic engineering using gene transfer from *Trichoderma harzianum* (endochitinase gene) to poplar varieties to enhance their resistance to pathogens (Noël et al 2005) Transgenic spruce lines seedling with resistance to *Cylindrocladium floridanum* in vitro, were successful demonstrated.

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## CONCLUSIONS

The work in a tree nursery suppose very much care, because from this activity depends the future forest development. One of the important thing is to assure a good, pathogen free biological material. In order to assure this, the seeds and seedlings and all the containers and working equipments must be very well disinfected. The preventive fungicide formulations is very good specialists.

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## Author' biography with Photo

### Dr. Sergiu Fendrihan

Dr in agronomical sciences Sergiu Fendrihan was born Campina, Romania, at 23.08.1955, and is employed in the Res Institute of Plant Protection. He worked in various biological domains like biological waste and waste water cleaning with biogas obtention, in Pharmacy, in biodeterioration and in astrobiology.He is now senior researcher in agricultural microbiology-pathogenic bacteria and fungi and antagonist, and associated professor of medical microbiology, virusology and parasitology in the University "Vasile Goldiș" from Arad, Romania. He worked in the extremophile research (halophilic Archaea) at the University of Salzburg, and in psychrophiles at The Romanian Institute of Polar Research. Is member and founder of some scientific association for example of Romanian Bioresource Center Association- with the purpose to reglement and bring toghether the culture collections of microorganisms animal human and vegetal cell lines from Romania.