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PHOMA TIP BLIGHT OF EASTERN WHITE PINE AND WESTERN WHITE PINE SEEDLINGS DORENA TREE IMPROVEMENT CENTER, OREGON

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ABSTRACT

Six western and six eastern white pine seedlings from the Dorena Tree Improvement Center (Oregon) with terminal or lateral branch dieback were analyzed in the laboratory for association with potentially-pathogenic fungi. *Phoma eupyrena* and *P. herbarum* were each isolated from five of the seedlings; two of the western white pine seedlings were infected with isolates of *Fusarium avenaceum*. All seedlings were infected with standard saprophytic fungi as well. *Phoma* spp. were likely the major causes of tissue necrosis on affected seedlings. Infection may have occurred at the nursery prior to shipment of seedlings to Dorena, although it is possible that seedlings became infected once they were planted for blister rust resistance screenings. The disease can be controlled by applications of chlorothalonil and culling heavily-infected seedlings.

INTRODUCTION

Seedlings grown in forest nurseries are prone to many diseases that can either cause mortality or adversely affect seedling utility. The USDA Forest Service Tree Improvement Center in Dorena, Oregon has a large program of screening five-needle pines for resistance to white pine blister rust (*Cronartium ribicola* Fisch.). Seedlings for this program are initially produced at other nurseries, especially the J.H. Stone Nursery in southern Oregon, and shipped to Dorena for resistance evaluations. Occasionally other, nursery-associated diseases may occur on these seedlings.

Recently, managers at the Dorena center noticed terminal and lateral branch dieback symptoms occurring on both western white (*Pinus monticola* Dougl.) and eastern white (*Pinus strobus* L.) seedlings. In several cases, terminal

leaders were affected (figure 1), where necrosis extended from the tip, down the main stem and into the center of the affected seedling. Sometimes necrotic terminals bent over (figure 2) indicating degradation of stem structural integrity. Necrotic tips sometimes also occurred on lateral branches (figure 3). Needle necrosis was evident within dieback portions of seedlings; necrosis usually started at needle tips and progressed downward to needle bases and fascicle sheaths.

Terminal and lateral branch dieback diseases are common on several pine species in forest nurseries (James 1984c, 1984d; James and Cooley 1987; James and Hamm 1985; James et al. 1987; Kliejunas and Allison 1983; Smith 1973; Srago et al. 1989) and usually associated with at least three different groups of fungi. The most damaging fungi are either *Sirococcus conigenus* Preuss (= *S. strobilinus*) or *Sphaeropsis sapinea* (Fr.) Dyko and Sutton (= *Diplodia pinea*)(Blodgett and Bonello 2003; Blodgett and Stanosz 1997, 1999; James 1979a, 1983b, 1985b, 1985c, 1986a, 1986b; 2001; Magasi et al. 1975). These two pathogens cause serious diseases not only in nurseries, but also in natural stands and plantations (Blodgett and Stanosz 1997, 1999; Feci et al. 2003; Funk 1972; James et al. 1979, 1991). The third group of fungi commonly associated with dieback of pine seedlings is *Phoma* (James 1979b, 1983a, 1984b, 1987b, 1990, 1998; James and Schwandt 1989; Srago et al. 1989). Pathogens from this genus are usually not as aggressive as either *Sirococcus* or *Sphaeropsis* (James 1983a, 1984a, 1984b; James and Hamm 1985), but may cause extensive damage under the right environmental conditions (James 1979b; James and Hamm 1985; Kliejunas and Allison 1983; Srago et al. 1989).

An evaluation was conducted to identify fungal organisms associated with terminal and lateral branch dieback of western and eastern white pine seedlings from the Dorena Tree Improvement Center.

MATERIALS AND METHODS

Six seedlings each of western and eastern white pine with dieback symptoms were evaluated. Isolations were made from at least one necrotic area from each seedling. Necrotic tissues were washed thoroughly and placed in standard moist chambers to induce sporulation of associated fungi. In addition, isolations were made from the margins between necrotic and healthy tissues. Thin, hand sections using aseptic techniques were made through the necrotic/healthy transition zones. Sections were surface sterilized in 10% bleach (0.525% aqueous sodium hypochlorite), rinsed in sterile water, blotted dry, and placed on 2% water agar. Agar plates were incubated at about 24°C on lab benches for 24-48 hours; emerging fungi were transferred to potato dextrose agar or carnation leaf agar (Fisher et al. 1982) for identification using taxonomic descriptions for the appropriate genera (Barnett and Hunter 1998; Dorenbosch 1970; Nelson et al. 1983).

Figure 1. Terminal leader dieback on western white pine seedling at the Dorena Tree Improvement Center

Figure 2. Terminal leader dieback on western white pine seedling at the Dorena Tree Improvement Center; necrotic terminal has bent over indicating loss of structural integrity.

Figure 3. Eastern white pine seedling with lateral branch dieback at the Dorena Tree Improvement Center.

RESULTS AND DISCUSSION

Three major fungal species, considered to be potential pathogens, were either isolated from necrotic tissues or sporulated on tissues incubated in moist chambers (table 1). The most commonly encountered genus was *Phoma*; two species (*P. eupyrena* Sacc. and *P. herbarum* Westend.) were often associated with dieback symptoms. Two of the western white pine seedlings were colonized with isolates of *Fusarium avenaceum* (Fr.) Sacc. Other fungi commonly isolated from incubated tissues included *Penicillium, Trichoderma, Aspergillus*, and *Aureobasidium*. All of these were considered standard saprophytes or secondary invaders of necrotic tissues.

Table 1. Potentially- pathogenic fungi associated with dieback of eastern and western white pine seedlings – Dorena Tree Improvement Center, Oregon.

Eastern White Pine (*Pinus strobus*)	
Seedling Number	Principal Isolated Potentially-Pathogenic Fungus
1	*Phoma eupyrena*
2	*Phoma eupyrena*
3	*Phoma herbarum*
4	*Phoma herbarum*
5	*Phoma eupyrena*
6	*Phoma herbarum*
Western White Pine (*Pinus monticola*)	
Seedling Number	Principal Isolated Potentially-Pathogenic Fungus
1	*Phoma eupyrena*
2	*Phoma herbarum*
3	*Fusarium avenaceum*
4	*Phoma eupyrena*
5	*Phoma herbarum*
6	*Fusarium avenaceum*

Based on isolation results and previous experience with similar diseases of conifer seedlings (James 1983a, 1984b, 1987b, 1990, 1998; James and Hamm 1985; James and Schwandt 1989), it was concluded that the major cause of terminal and lateral branch dieback of white pine seedlings at Dorena was *Phoma* spp. Of the two species frequently isolated, *P. eupyrena* is generally considered to have the greatest pathogenic potential on conifer seedlings (Domsch et al. 1980; James 1983a, 1984b, 1998, James and Hamm 1985; Srago et al. 1989). This species is not only associated with dieback symptoms, but may cause seedling mortality when inoculum levels are high, when cool, wet weather persists and when seedlings are stressed (James 1979b; James and Hamm 1985; Kliejunas and Allison 1983; Srago et al. 1989). *Phoma eupyrena* is a common soil inhabitant in bare root nurseries and readily disseminated to all production fields (James and Hamm 1985). On the other hand, *P. herbarum* has been encountered less frequently, although it may be isolated from diseased seedlings (Boerema 1964; James 1984b, 1985a; James and Hamm 1985).

Fusarium avenaceum is a common nursery soil-inhabiting fungus. It has been considered pathogenic on a wide range of different plants (Duthie et al. 1986; Kiecana et al. 2002), including various nursery crops (Gurusiddaiah et al. 1979; Mwanza and Kellas 1987) and conifer seedlings (Asiegbu et al. 1999; Gordon 1959; Hoefnagels and Linderman 1999; James 1987a, 1993; James et al. 1989; Morgan 1983; Tint 1945a, 1945b;) However, in most cases, it is believed to be either a weak pathogen (Asiegbu et al. 1999; Johnston and Greaney 1942; Parry and Pegg 1985; Stack and McMullen 1985) or nonpathogenic (Burgess et al. 1975; Rathbun-Gravatt 1931). However,

recently *F. avenaceum* was found causing extensive needle, branch, and stem necrosis and mortality on container-grown ponderosa pine seedlings (James 2003). Apparently, there is much variation among different isolates of *F. avenaceum* (Forbes and Dickinson 1977; Sangalang et al. 1995).

Dieback diseases of conifer seedlings can be successfully controlled by proper application of fungicides, particularly chlorothalonil which has wide efficacy on foliar pathogens (James 1986b, 2001; James et al. 1987; Kliejunas and Allison 1983; Smith 1973; Srago et al. 1989). Generally, applications once every two weeks or immediately after rain or irrigation should provide adequate protection from disease-causing fungi (James 2001; James et al. 1987; Kliejunas and Allison 1983). Severely-affected seedlings should probably be culled to reduce chances of secondary spread (James 2001; James et al. 1987; Srago et al. 1987) after seedlings are planted for resistance screening at Dorena.

It is possible that seedlings initially became infected while being grown at a nursery. Perhaps some infected seedlings that lacked noticeable disease symptoms were shipped from the nursery. Since it may take time between infection and symptom development (Domsch et al. 1980; Dorenbosch 1970; James and Hamm 1985), growers may be unaware that infected seedlings leave their nursery. If disease severity increases in the future, steps to limit disease, such as nursery fungicide applications, may be warranted.

LITERATURE CITED

Asiegbu, F.O., M. Johansson and J. Stenlid. 1999. Reactions of *Pinus sylvestris* (Scots pine) root tissues to the presence of mutualistic, saprotrophic and necrotrophic microorganisms. Journal of Phytopathology 147:257-264.

Barnett, H.L. and B.B. Hunter. 1998. Illustrated genera of imperfect fungi. Fourth Edition. The American Phytopathological Society Press, St. Paul, MN. 218p.

Blodgett, J.T. and P. Bonello. 2003. The aggressiveness of *Sphaeropsis sapinea* on Austrian pine varies with isolate group and site of infection. Forest Pathology 33:15-19.

Blodgett, J.T. and G.R. Stanosz. 1997. *Sphaeropsis sapinea* morphotypes differ in aggressiveness, but both infect nonwounded red or jack pines. Plant Disease 81:143-147.

Blodgett, J.T. and G.R. Stanosz. 1999. Differences in aggressiveness of *Spheropsis sapinea* RAPD marker group isolates on several conifers. Plant Disease 83:853-856.

Boerema, G.H. 1964. *Phoma herbarum*, the type-species of the form-genus *Phoma*. Persoonia 3:9-16.

Burgess, L.W., A.H. Wearing and T.A. Toussoun. 1975. Surveys of Fusaria associated with crown rot of wheat in eastern Australia. Australian Journal of Agricultural Research 26:791-799.

Domsch, K.H., W. Gams and T.-H. Anderson. 1980. Compendium of soil fungi. Volume 2. Academic Press, New York. 859p.

Dorenbosch, M.M.J. 1970. Key to nine ubiquitous soil-borne *Phoma*-like fungi. Persoonia 6:1-14.

Duthie, J.A., R. Hall and A.V. Asselin. 1986. *Fusarium* species from seed of winter wheat in eastern Canada. Canadian Journal of Plant Pathology 8:282-288.

Feci, E., D. Smith and G.R. Stanosz. 2003. Association of *Sphaeropsis sapinea* with

insect-damaged red pine shoots and cones. Forest Pathology 33:7-13.

Fisher, N.L., L.W. Burgess, T.A. Toussoun and P.E. Nelson. 1982. Carnation leaves as a substrate and for preserving cultures of *Fusarium* species. Phytopathology 72:151-153.

Forbes, R.S. and C.H. Dickinson. 1977. Effects of temperature, pH and nitrogen on cellulolytic activity of *Fusarium avenaceum*. Transactions of the British Mycological Society ;68:229-235.

Funk, A. 1972. Sirococcus shoot-blight of western hemlock in British Columbia and Alaska. Plant Disease Reporter 56:645-647.

Gurusiddaiah, S., L.D. Winwood, D. Burger and S.O. Graham. 1979. Pantomycin: a new antimicrobial antibiotic. Mycologia 71:103-118.

Gordon, W.L. 1959. The occurrence of *Fusarium* species in Canada. VI. Taxonomy and geographic distribution of *Fusarium* species on plants, insects, and fungi. Canadian Journal of Botany 37:257-290.

Hoefnagels, M.H. and R.G. Linderman. 1999. Biological suppression of seedborne *Fusarium* spp. during cold stratification of Douglas-fir seeds. Plant Disease 83:845-852.

James, R.L. 1979a. An evaluation of *Diplodia pinea* on Austrian pine seedlings at Bessey Nursery, Nebraska. USDA Forest Service, Rocky Mountain Region, Forest Pest Management. Biological Evaluation R2-79-1. 5p.

James, R.L. 1979b. Lodgepole pine seedling chlorosis and mortality at Bessey Nursery, Nebraska. USDA Forest Service, Rocky Mountain Region, Forest Pest Management. Biological Evaluation R2-79-2. 10p.

James, R.L. 1983a. Phoma blight of conifer seedlings. USDA ForestService, Northern Region, Forest Pest Management. Nursery Disease Notes No. 3. 8p.

James, R.L. 1983b. *Sirococcus strobilinus* on containerized Engelmann spruce seedlings at the Coeur d'Alene Nursery, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Report 83-20. 3p.

James, R.L. 1984a. Characteristics of *Diplodia pinea* associated with tip dieback of ponderosa pine seedlings. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 13. 5p.

James, R. L. 1984b. Characteristics of *Phoma* isolates from nurseries of the Pacific Northwest Region. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 14. 26p.

James, R.L. 1984c. Mortality of Mugo pine seedlings at the Fantasy Farms Nursery, Peck, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 10. 7p.

James, R.L. 1984d. Tip blight of ponderosa pine seedlings at the Fantasy Farms Nursery, Peck, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Report 84-3. 7p.

James, R.L. 1985a. Characteristics of *Phoma herbarum* isolates from diseased forest tree seedlings. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 22. 6p.

James, R.L. 1985b. Diplodia tip blight of 1-0 ponderosa pine seedlings at the USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 17. 3p.

James, R.L. 1985c. Sirococcus tip blight on bareroot Engelmann spruce seedlings at the Clifty View Nursery, Bonners Ferry, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 19. 3p.

James, R.L. 1986a. Diplodia tip blight of ponderosa pine seedlings at the Fantasy Farms Nursery, Peck, Idaho - 1986 update. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 36. 2p.

James, R.L. 1986b. Sirococcus tip blight of bareroot pine seedlings at the Champion

Timberlands Nursery, Plains, Montana. USDA Forest Service, Northern Region, Forest Pest Mangement. Nursery Disease Notes No. 33. 3p.

James, R.L. 1987a. Occurrence of *Fusarium* spp. on conifer tree seed from Northern Rocky Mountain nurseries. *In*: Landis, T.D. (tech. coord.). Proceedings: Combined Western Nursery Council and Intermountain Nursery Association Meeting. USDA Forest Service, General Technical Report RM-137. pp. 104-114.

James, R.L. 1987b. Phoma tip blight of bareroot lodgepole pine seedlings, Champion Timberlands Nursery, Plains, Montana. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 57. 4p.

James, R.L. 1990. Phoma tip blight of bareroot Engelmann spruce seedlings - Montana State Nursery, Missoula. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 97. 3p.

James, R.L. 1993. *Fusarium* species associated with post-emergence damping-off and root disease of young container-grown Douglas-fir seedlings - USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 129. 5p.

James, R.L. 1998. Phoma branch dieback of 3-0 bareroot Douglas-fir seedlings - USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Northern Region, Forest Health Protection. Nursery Disease Notes No. 136. 5p.

James, R.L. 2001. Outbreak of *Sirococcus strobilinus* on 2-0 ponderosa and lodgepole pine seedlings - USDA Forest Service Nursery, Coeur d'Alene, Idaho. USDA Forest Service, Northern Region, Forest Health Protection. Nursery Disease Notes No. 142. 7p.

James, R.L. 2003. Fusarium blight of container-grown ponderosa pine seedlings – Montana State Nursery, Missoula, Montana. USDA Forest Service, Northern Region, Forest Health Protection. Nursery Disease Notes No. 149. 14p.

James, R.L. and S.J. Cooley. 1987. Tip blight of bareroot ponderosa pine and lodgepole pine seedlings - USDA Forest Service Nursery, Bend, Oregon. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 62. 5p.

James, R.L., R.K. Dumroese and D.L. Wenny. 1989. Occurrence, characteristics, and descriptions of *Fusarium* isolates from Douglas-fir seed and seedlings. USDA Forest Service, Northern Region, Forest Pest Management. Report 90-4. 23p.

James, R.L. and P.B. Hamm. 1985. Chlamydospore-producing species of *Phoma* from conifer seedlings in Pacific Northwest forest tree nurseries. Proceedings of the Montana Academy of Sciences 45:26-36.

James, R.L., D.W. Johnson and W.G. Telfer. 1979. Diplodia tip blight of ponderosa pine in the Black Hills, South Dakota. USDA Forest Service, Rocky Mountain Region, Forest Pest Management. Biological Evaluation R2-79-8. 10p.

James, R.L., R.L. Mathiasen and J.W. Schwandt. 1991. Sphaeropsis blight of ponderosa pine in northern Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Report 91-10. 8p.

James, R.L. and J.W. Schwandt. 1989. Phoma blight of bareroot Japanese black pine seedlings - Fantasy Farms Nursery, Peck, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Nursery Disease Notes No. 90. 3p.

James, R.L., J.W. Schwandt and J.Y. Woo. 1987. An evaluation of fungicides to control Diplodia tip blight at the Fantasy Farms Nursery, Peck, Idaho. USDA Forest Service, Northern Region, Forest Pest Management. Report 87-10. 4p.

Johnston, C.L. and F.J. Greaney. 1942. Studies on the pathogenicity of *Fusarium* species associated with root rot of wheat. Phytopathology 32:670-684.

Kiecana, I., E. Mielniczuk, Z. Kaczmarek, M. Kostecki and P. Golinski. 2002. Scab response and moniliformin accumulation in kernals of

oat genotypes inoculated with *Fusarium avenaceum* in Poland. European Journal of Plant Pathology 108:245-251.

Kliejunas, J. and J. Allison. 1983. Evaluation of fungicides for control of Phoma blight of red fir and Sirococcus tip blight of Jeffrey pine at the Humboldt Nursery. USDA Forest Service, Pacific Southwest Region, Forest Pest Management. Report No. 83-22. 8p.

Magasi, L.P., S.A. Manley and R.E. Wall. 1975. *Sirococcus strobilinus*, a new disease of spruce seedlings in Maritime nurseries. Plant Disease Reporter 59:664.

Morgan, P. 1983. Fusarium stem rot of Douglas-fir seedlings. Plant Disease 67:441-442.

Mwanza, E.J.M. and J.D. Kellas. 1987. Identification of the fungi associated with damping-off in the regeneration of *Eucalyptus obliqua* and *E. radiata* in a central Victoria forest. European Journal of Forest Pathology 17:237-245.

Nelson, P.E., T.A. Toussoun and W.F.O. Marasas. 1983. *Fusarium* species: an illustrated manual for identification. The Pennsylvania State University Press, University Park. 193p.

Parry, D.W. and G.F. Pegg. 1985. Surface colonization, penetration and growth of three *Fusarium* species in Lucerne. Transactions of the British Mycological Society 85:495-500.

Rathbun-Gravatt, A. 1931. Germination loss of coniferous seeds due to parasites. Journal of Agricultural Research 42:71-92.

Sangalang, A.E., B.A. Summerell, L.W. Burgess and D. Backhouse. 1995. Taxonomy of *Fusarium*: characterization of *Fusarium avenaceum* subsp. *aywerte* and *Fusarium avenaceum* subsp. *nurragi*. Mycological Research 99:287-290.

Smith, R.S., Jr. 1973. Sirococcus tip dieback of *Pinus* spp. in California forest nurseries. Plant Disease Reporter 57:69-73.

Srago, M.D., R.L. James and J.T. Kliejunas. 1989. Phoma blight. *In*: Cordell, C.E., R.L. Anderson, W.H. Hofford, T.D. Landis, R.S. Smith, Jr., and H.V. Toko (tech. coords.). Forest Nursery Pests. USDA Forest Service, Agricultural Handbook. No. 680. pp. 54-55.

Stack, R.W. and M.P. McMullen. 1985. Head blighting potential of *Fusarium* species associated with spring wheat heads. Canadian Journal of Plant Pathology 7:79-82.

Tint, H. 1945a. Studies in the *Fusarium* damping-off of conifers. I. The comparative virulence of certain Fusaria. Phytopathology 35:421-439.

Tint, H. 1945b. Studies in the *Fusarium* damping-off of conifers. II. Relation of age of host, pH, and some nutritional factors to the pathogenicity of *Fusarium*. Phytopathology 35:440-457.

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