NURSERY DISEASE NOTES USDA FOREST SERVICE NORTHERN REGION

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FUSARIUM SPORODOCHIA ON CONTAINER-GROWN PONDEROSA PINE SEEDLINGS - USDA FOREST SERVICE NURSERY, COEUR D'ALENE, IDAHO

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Fusarium spp. cause important diseases of container-grown conifer seedlings, including damping-off and cotyledon blight of young germinants and root disease of older seedlings (James 1986; James and others 1988). Several different species of *Fusarium* have been implicated in these diseases (James and others 1989b); some strains may be aggressive pathogens, whereas others are mostly saprophytic and do not elicit disease symptoms (James and others 1989a).

Orange-colored structures are sometimes present on the outside of discarded seedcoats, on perlite covering the tops of containers, or on the stem at the base of diseased seedlings (figure 1). These are spore-producing structures of *Fusarium* termed sporodochia. When growers notice numerous sporodochia in their container seedling operations, they usually consider that they will have a *Fusarium* problem and may initiate fungicide applications.

Several different *Fusarium* species are capable of producing sporodochia (Booth 1971; Gerlach and Nirenberg 1982; Nelson and others 1983). Some of these species are not considered pathogens of conifer seedlings, whereas others are important pathogens (James and others 1989b). Also, sporodochia are not always produced when *Fusarium* diseases occur (James and others 1988). Unfortunately, individual *Fusarium* species cannot reliably be delineated on the basis of sporodochial production (Nelson and others 1983).

During the 1991 crop of container-grown ponderosa pine (*Pinus ponderosa* Laws.) seedlings at the USDA Forest Service Nursery in Coeur d'Alene, Idaho, extensive production of sporodochia was noticed on recently-discarded seedcoats and on the surface of perlite and vermiculite within containers (figure 1). These sporodochia were light-orange in color and relatively abundant even though there was little evidence of disease, i.e., very few of the seedlings displayed above-ground disease symptoms. Microscopic examination of a few seedlings indicated that their roots were mostly healthy with little decay.

Growers were concerned that the abundant sporodochia might indicate a *Fusarium* threat to the ponderosa pine and nearby crops of other seedlings. An evaluation was conducted to determine which *Fusarium* species produced these structures in order to predict possible disease potential.

Figure 1. *Fusarium* sporodochia produced on seedcoat of ponderosa pine (right) and on perlite and vermiculite growing media at the USDA Forest Service Nursery, Coeur d'Alene, Idaho.

Twenty randomly-selected sporodochia growing either on discarded seedcoats or on the surface of perlite and vermiculite were transferred from containers to a selective agar medium for *Fusarium* spp. (Komada 1975). The sporodochia were incubated on the media for 7 days at about 24°C under diurnal cycles of cool, fluorescent light. Fungi growing vegetatively from sporodochia were transferred to potato dextrose agar (PDA) and carnation leaf agar (CLA) for identification. The taxonomic scheme of Nelson and others (1976) was used for species identification.

Six species of *Fusarium* were isolated from sporodochia growing on the top of ponderosa pine containers (table 1). The most commonly isolated species was *F. proliferatum* (Matsushima) Nirenberg, which was obtained from 65% of the samples. This species produced sporodochia on seed, perlite and vermiculite. Two other species of similar morphology isolated from sporodochia were *F. moniliforme* Sheldon and *F. oxysporum* Schlecht. *Fusarium proliferatum* and *F. moniliforme* are both in the taxonomic section *Liseola* and differ from each other on the basis of microconidiophore morphology (Booth 1971; Nelson and others 1983). Both these species resemble *F. oxsyporum* in gross colony morphology on artificial media (PDA) (Nelson and others 1983), and therefore confusion in identification can occur.

In the past, when sporodochia are present on container-grown conifer seedlings, they are usually considered to be produced by *F. oxysporum* (James and others 1989b; Landis 1976). However,

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closely-related species may have frequently been mis-identified as *F. oxysporum*. Not all morphologically-similar *Fusarium* species have equal ability to cause disease of conifer seedlings (James and others 1989a). *Fusarium oxysporum* is well-known as a pathogen (Bloomberg 1976; Hildebrand 1985); likewise, *F. moniliforme* has also been implicated as potentially an important pathogen of conifer seedlings (Hartley and others 1918; Hildebrand 1985). However, pathogenicity of *F. proliferatum* on conifer seedlings has not been evaluated. Although this species is readily isolated from both diseased and non-diseased seedlings (James 1990, 1991a, 1991b), it may or may not be an important pathogen. Also, there are different strains of all three species that likely vary in their ability to elicit disease symptoms on conifer seedlings (James and others 1989b). Since these variable strains are not readily distinguished on the basis of morphological characteristics (Bloomberg and Lock 1972; Gordon and others 1989), pathogenicity tests or genetic analyses are required to differentiate pathogenic from non-pathogenic strains (Bloomberg 1981; Booth 1984).

The other three species of *Fusarium* isolated from sporodochia were *F. acuminatum* Ell. & Ev., *F. sambucinum* Fuckel, and *F. sporotrichioides* Sherb. (table 1). Although all three species produce carmine-red pigmentation in culture, they are relatively easily separated from each other on the basis of production of microconidia and macroconidia and microconidiophore morphology (Nelson and others 1983). Each species is located in a different taxonomic section (*F. acuminatum* = *Gibbosum*; *F. sambucinum* = *Discolor*; *F. sporotrichioides* = *Sporotrichiella*). Some isolates of *F. acuminatum* are aggressive pathogens of conifer seedlings (Hildebrand 1985; James and others 1989a); others are very weak pathogens (Rathbun-Gravatt 1925) or saprophytic (Hartley and others 1918). Most isolates of *F. sambucinum* tested have been weak pathogens of conifer seedlings (James and others 1989a; Tint 1945). *Fusarium sporotrichioides*, although infrequently isolated from conifer seedlings (Rathbun 1922), is often highly virulent in controlled pathogenicity tests (Hangyalne 1975; Hartley and others 1918; Rathbun 1922).

Production of sporodochia on the surface of ponderosa pine seedcoats and on the surfaces of growing media is a good indicator for presence of *Fusarium*. However, we are currently unable to easily differentiate *Fusarium* species on the basis of sporodochial production or determine whether these fungi are pathogens or non-pathogens. Because several *Fusarium* species can produce sporodochia during periods of high temperature and humidity, presence of sporodochia does not necessarily predict that disease will occur. In the case of the 1991 crop of ponderosa pine at the Coeur d'Alene Nursery, very little disease occurred despite extensive production of *Fusarium* sporodochia on the surface of containers. We suspect that most of the fusaria were saprophtic.

Table 1. Isolations from individual sporodochia growing externally on discarded seedcoats of ponderosa pine or on the surface of perlite or vermiculite at the tops of pine cell containers - USDA Forest Service Nursery, Coeur d'Alene, Idaho.

Sample No.	Location	Fusarium Species Isolated
1	Seedcoat	*moniliforme*; *sambucinum*
2	Seedcoat	*sambucinum*
3	Seedcoat	*proliferatum*
4	Perlite	*proliferatum*; *sambucinum*
5	Vermiculite	*proliferatum*; *sambucinum*
6	Seedcoat	*proliferatum*; *sambucinum*
7	Seedcoat	*proliferatum*; *oxysporum*
8	Vermiculite	*oxysporum*
9	Seedcoat	*acuminatum*
10	Perlite	*proliferatum*; *acuminatum*; *sambucinum*
11	Perlite	*moniliforme*; *sporotrichioides*
12	Seedcoat	*proliferatum*; *sporotrichioides*
13	Perlite	*proliferatum*
14	Vermiculite	*proliferatum*
15	Seedcoat	*acuminatum*
16	Perlite	*proliferatum*; *sporotrichioides*
17	Vermiculite	*proliferatum*; *sambucinum*
18	Seedcoat	*proliferatum*
19	Seedcoat	*proliferatum*; *acuminatum*
20	Vermiculite	*acuminatum*

Percentage of samples colonized with appropriate fusaria:

F. proliferatum	=	65%
F. sambucinum	=	35%
F. acuminatum	=	25%
F. sporotrichioides	=	15%
F. moniliforme	=	10%
F. oxysporum	=	10%

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