Special Report

New Host and Distribution Records from Pennsylvania Conifers

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ABSTRACT

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Yellow broom rust of fir caused by *Melampsorella caryophyllacearum*: first record on *Abies fraseri* and southernmost record on *Abies* in eastern North America. Autoecious spruce needle rust caused by *Chrysomyxa weirii*: first report from Pennsylvania, first record of severe damage to Christmas trees in the eastern United States, and second record on *Picea pungens*. Seedling blight caused by *Discosia pini*: first record in eastern United States and first record on *Pseudotsuga menziesii*. Branch and stem cankers of *P. menziesii* caused by *Dermea pseudotsugae*: first report from eastern North America and first report of extensive mortality of Christmas trees. Branch and stem cankers of *P. menziesii, Abies balsamea*, and *A. fraseri* caused by *Leucostoma kunzei*: first record on *A. fraseri* and first record of extensive mortality of Christmas trees. *Diaporthe lokoyae* associated with chlorosis and dieback of branches of stressed *Picea pungens*: first record on *P. pungens* and first record in eastern North America.

This report covers *Melampsorella caryophyllacearum* on *Abies fraseri; Chrysomyxa weirii* on *Picea pungens; Discosia pini* on *Pseudotsuga menziesii; Dermea pseudotsugae* on *P. menziesii; Leucostoma kunzei* on *Abies balsamea, A. fraseri*, and *P. menziesii*; and *Diaporthe lokoyae* on *P. pungens.*

Melampsorella caryophyllacearum* on *Abies fraseri. Yellow broom rust of fir, caused by the heteroecious, macrocyclic rust fungus *Melampsorella caryophyllacearum* J. Schröt., is widespread on *Abies balsamea* (L.) Mill. throughout its range and has been reported on that host from Maine, New Hampshire, Vermont, Connecticut, New York, Michigan, and Minnesota (6), as well as across Canada from Newfoundland to Alberta (11). The fungus also occurs on other species of *Abies* throughout western North America from Alaska to Mexico (2). The report from British Columbia (14) of "*Melampsorella caryophyllacearum* Schroet., yellow witches' broom, . . . widely scattered on Douglas-fir, but caused little damage . . ." obviously was either a mistake in reporting or misidentification of the host. The fungus has been collected from the telial host (*Stellaria* spp.) in Pennsylvania (6) but has never been found on the aecial host (7). We have not found it on native *A. balsamea* in repeated searches of the Bear Meadows Natural Area in Huntingdon County, Pennsylvania, a remnant boreal bog where both hosts occur.

On 5 May 1991, a conspicuous loose witches'-broom composed of naked twigs with living buds was noted on a 2-m-tall *A. fraseri* (Pursh) Poir. Christmas tree in Tioga County, Pennsylvania. The broom was about 0.85 m wide by 0.4 m thick and, according to twig growth, 6 or 7 yr old. The broom appeared identical to those encountered on *A. balsamea* Christmas trees throughout northern New England. The buds on the broom were beginning to open, although buds on healthy twigs had not begun to swell. The broom was reexamined on 26 June 1991; new shoots were light yellowish green and 10–12 cm long and possessed short, thickened, yellowish green needles. Healthy shoots on the same tree were about 5 cm long. Aecia had not yet begun to form. Aecia formed in mid-July, and infected needles were cast in early August. Pathological anatomy of infected needles was similar to that on *A. balsamea* (19). This is the first report of this pathogen on *A. fraseri* and represents a significant southward extension of its known range on its aecial hosts in eastern North America.

The brooms are rarely seen in sheared Christmas trees until the brooms are several years old. Removal of the broom at that time usually leaves a "hole" in the side of the tree, thus significantly reducing the tree's salability. We have observed disease incidence up to 10% in some New England *A. balsamea* plantations. With increasing hectarages being planted to true firs, the importance of this disease in Christmas tree production has yet to be assessed in the mid-Atlantic states.

Chrysomyxa weirii* on *Picea pungens. Autoecious spruce needle rust, caused by *Chrysomyxa weirii* H. Jacks., occurs on *Picea engelmannii* Parry ex Engelm. in Oregon, Washington, British Columbia, Idaho, and western Montana (1,12); on *P. sitchensis* (Bong.) Carrière in British Columbia (15); and on *P. rubens* Sarg. in New Brunswick (4) and in the high mountains of West Virginia and Tennessee (1). Annual reports of the Forest Insect and Disease Survey of Forestry Canada from 1947 to 1985 show that this fungus also has been found attacking *P. glauca* (Moench) Voss throughout Canada from Quebec to British Columbia; *P. mariana* (Mill.) B.S.P. in Quebec, Manitoba, and Alberta; *P. rubens* in Nova Scotia; and *P. engelmannii* in Quebec and Alberta. Bergdahl and Smeltzer (3) reported it attacking *P. pungens* Engelm. in a nursery in northern Vermont.

On 24 May 1991, rust-infected 1990 needles from *P. pungens* Christmas trees from Luzerne County, Pennsylvania, were received in Penn State's Plant Disease Clinic. The sori contained deciduous teliospores matching the description of those of *C. weirii*. Examination of the plantation on 4 June 1991 showed lower branches on severely infected 2- to 3.5-m-tall, 12- to 15-yr-old trees were devoid of all needle complements except those of 1990 and 1991. Adjacent noninfected trees bore needle complements from 1987. Severely infected older trees (approximately 30–60% in different blocks of the stand) on about 1 ha lost virtually all 1990 needles. Trace to moderate levels of infection occurred on scattered younger trees throughout another 4 ha. Present owners had no records concerning the source of the seedlings in the severely infected, older portion of the stand. In June 1992, three infected ornamental *P. pungens* were found in Scranton, Pennsylvania. These trees had been purchased "ball-and-burlap" 5 yr previously. The current property owner had no records of where the plants had been purchased; the pathogen obviously exists in some nursery. This is the first record of this pathogen in Pennsylvania, the second report of it on *P. pungens*, and the first report of

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it causing severe damage to *P. pungens* Christmas trees.

Like the majority of needle rust fungi, *C. weirii* infects succulent needles on expanding current-year shoots. However, all other spruce needle rusts produce aecia on current-year needles during the summer. Although *C. weirii* causes the development of small chlorotic spots on infected needles within 2–4 wk after infection, these spots mimic feeding damage by various insects and mites. Histological sections will reveal telial initials forming during the fall (18). However, in relation to regulatory pathology, the fungus produces no truly diagnostic signs and symptoms until about 11 mo after infection. Then, 2–3 wk before budbreak, telial sori develop in chlorotic spots on infected previous-year needles. The waxy, reddish orange telial pustules erupt through the epidermis just prior to budbreak. Spore liberation and infection of new current-year needles occur during the 2–3 wk following budbreak if moisture is available. Infected previous-year needles then rapidly shrivel and cast. Thus, all really definitive signs and symptoms are evident over about a 4- to 6-wk period, and nursery inspection and other regulatory activities for this disease must be carried out during that limited period.

About 22% of the Christmas tree hectarage in Pennsylvania is composed of *P. pungens*. It also is widely planted as an ornamental throughout the Northeast and mid-Atlantic. Many Christmas tree growers as well as a large number of landscape nurseries sell "ball-and-burlap" planting stock. Given the widespread commercial movement of *P. pungens* and the short window for completing regulatory activities, this pathogen poses a threat to the mid-Atlantic nursery industry should it become more widely distributed.

***Discosia pini* on *Pseudotsuga menziesii*.** *Discosia pini* Heald was first associated with a needle blight of *Pinus ponderosa* Douglas ex P. Laws. & C. Laws. seedlings in Nebraska in 1907 (10). Since then it has been reported from Romania as causing an economically important needle blight of seedlings of *P. sylvestris* L. and "other conifers" (9); from a nursery in southern Ontario as causing a needle blight of *P. banksiana* Lamb. (5); from several nurseries in Shimane Prefecture of Japan as causing a needle blight of *P. densiflora* Siebold & Zucc. and *P. thunbergii* Parl. (16); and from Kyoto, Japan, as causing a needle blight of *Cunninghamia lanceolata* (Lamb.) Hook. (13). Suto (16) completed Koch's' postulates using *P. densiflora*.

On 5 September 1991, we received 3-mo-old *Pseudotsuga menziesii* (Mirb.) Franco seedlings from a nursery in Carbon County, Pennsylvania. Patches of seedlings scattered through the nursery beds were severely stunted and chlorotic and were rapidly dying and turning brown. Stems of many seedlings were crooked and/or showed spindle-shaped swellings and stem cracking. Primary needles were very stunted or absent. The distinctive pycnidia and conidia of *D. pini* were abundant on stems and cotyledons of partially green, chlorotic, and dead seedlings.

The nursery had fumigated with methyl bromide and chloropicrin in the fall of 1990 and had sown half the beds that fall. The other beds were sown in June 1991 with the remainder of the same seed lot. The fall-sown beds were annihilated by the disease; there was no detectable disease in the adjacent spring-sown beds. We believe that the fungus attacked the dormant fall-sown seeds in the soil during the winter months. This is the first record of this disease on *P. menziesii* and the first record of it in the eastern United States.

***Dermea pseudotsugae* on *Pseudotsuga menziesii*.** In 1981, a plantation of *P. menziesii* Christmas trees was established in Carbon County, Pennsylvania, in a field that had been in hay or field crops for about 150 yr. The soil had been eroded and depleted of nutrients and consisted primarily of the shaley subsoil. Following a severe drought in 1988, this plantation was severely damaged by branch and stem cankers; approximately 12,000 1- to 1.5-m-tall dead or dying trees have been cut and burned (>50% of the stand).

First symptoms included a stunting of the current-year shoots, which then turned a pale whitish green and died. These dead shoots often resembled the thorns of a hawthorn, sharply pointed and lacking any terminal bud cluster. There usually was a faint constriction between healthy and dead portions of these twigs. The cankers gradually progressed back into the main stem. Usually there was slight to moderate resin flow from the cankered portion of the main stem and sometimes from cankered larger branches, often emanating from a constriction caused by collapse of the killed cortex and cambium.

Two fungi appear to be involved in this mortality and have been cultured from cortical tissues at the advancing margins of the cankers. One we have not yet been able to identify. The other is *Dermea pseudotsugae* Funk (anamorph = *Foveostroma boycei* (Dearn.) Funk), previously reported only in western North America from British Columbia south to California (8). In Pennsylvania, the distinctive *Foveostroma* conidiomata formed occasionally on canker faces throughout the fall and winter months and abundantly throughout the following spring. Apothecia with asci and ascospores were found from mid-February through April. This is the first report of this pathogen in eastern North America.

***Leucostoma kunzei* on *Abies balsamea*, *A. fraseri*, and *Pseudotsuga menziesii*.** Pennsylvania hectarage of *Pinus sylvestris* Christmas trees has declined over the past decade, having been replaced principally by *P. menziesii*, which now composes about 50% of the state's Christmas tree hectarage. Because of difficulties in controlling Rhabdocline needlecast, many growers have been converting these stands to *A. fraseri* and in some instances to *A. balsamea*. Large hectarages of all three replacement species have been planted on poor sites, e.g., shallow stony soils, heavy clay soils, and strip mine spoil banks. Although these low-quality sites can produce acceptable crops of the site-tolerant *P. sylvestris*, the replacement species are far more site-demanding, and concurrent with this shift in species, incidence of branch and stem cankers has increased.

Several weakly pathogenic fungi can cause branch and stem cankers on Douglas-fir (8). In most instances, these fungi appear to attack stressed trees, such as those planted on poor sites or affected by drought. Other than some brief descriptions in the literature, these diseases have been little studied, especially in the Northeast. One of these canker fungi is *Leucostoma kunzei* (Fr.:Fr.) Munk (anamorph = *Cytospora kunzei* Sacc.).

Branch and stem cankers of Douglas-fir caused by "*Valsa kunzei*" (Fr.:Fr.) Fr. were first described by Waterman in 1955 (17). She cultured the fungus from cankered trees from Washington (D.C.?), Pennsylvania, Vermont, New Hampshire, and Massachusetts and gave the first detailed descriptions of the cankers and the fungus. She also noted that cankered trees usually occurred on unfavorable sites or had been weakened by other environmental factors. Farr et al (6) reports *L. kunzei* canker and dieback of conifers in the temperate Northern Hemisphere, specifically on *A. balsamea* in Michigan, *Picea engelmannii* in Colorado, and *Pseudotsuga menziesii* in Washington and Oregon.

A mixed planting of *A. balsamea, A. fraseri*, and *P. menziesii* in Tioga County, Pennsylvania, incurred extensive dieback and mortality beginning in 1989, 1 yr after a severe drought. Parallel strips of trees several rows wide across the plantation were affected. These strips coincided with areas of shallow soil over sandstone outcroppings, i.e., sites more affected by the drought. Cankered branches occurred throughout the trees; these cankers progressed into the main stems, girdling them. Trees whose lower stems survived set multiple replacement leaders in 1989 and 1990. Following another severe drought in 1991, the cankers advanced further down the stems, killing the replacement leaders and frequently the entire tree. Trees not previously infected also developed multiple branch and stem cankers.

The asexual stage of the pathogen developed on the bark of the stems and larger branches the first year after death; the second year after death, the sexual stage developed. Fruiting was abundant on all three host species. Approximately 10% of the 1.2-ha stand was killed, and many of the other trees were severely cankered. The entire stand was rogued and burned. This is the first confirmation of this pathogen on *A. fraseri* and the first record of extensive damage and mortality in Christmas trees.

***Diaporthe lokoyae* on *Picea pungens*.** In September 1991, *Diaporthe lokoyae* Funk was discovered on 1- to 1.5-m-tall *Picea pungens* in a Chester County, Pennsylvania, Christmas tree plantation. The trees, planted in 1984 on clay soil of low fertility, became increasingly symptomatic beginning in 1988. On many trees, scattered branches or groups of branches were chlorotic and dying. Perithecia were discovered along such discolored branches 5–8 mm in diameter. A species of *Phomopsis*, fitting within the limits of *P. lokoyae* Hahn, was readily isolated from cortical tissues of symptomatic branches. For many years, we have cultured numerous isolates of *Phomopsis* from similar chlorotic or dying conifers in Pennsylvania, especially firs and Douglas-fir; these have been unidentifiable because of overlap in sizes of the asexual spores of the various species attacking conifers. This is the first time we have found the sexual stage of one of these fungi. *D. lokoyae* has been previously reported only from the western United States and Canada, causing cankers and dieback in *Pseudotsuga, Thuja*, and *Tsuga*, usually associated with stress (8). This is the first report of it from eastern North America and the first report of it attacking *Picea pungens*.

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