to their lawns in recent years, first noticed a slight yellowing in their lawns in the summer of 1980. It is difficult to determine whether the present occurrence of the disease is the result of previously undetected infection sites or whether the virus has been introduced recently with sod. Because St. Augustinegrass is not produced in Arkansas, the original source of infected turf was probably sod imported from other states.

Control of SAD in Arkansas will probably depend upon use of virus-resistant cultivars. Although the Floratam cultivar is resistant to SAD-PMV (5,7), it is not cold tolerant. The Raleigh cultivar (NCSA 21) is also SAD-PMV resistant (1), and it may be sufficiently winter hardy for use in central and southern Arkansas. It will be tested for SAD-PMV resistance and cold tolerance in central Arkansas.

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First Report of *Verticicladiella procera* on Pines in Minnesota

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ABSTRACT

Livingston, W. H., and Wingfield, M. J. 1982. First report of *Verticicladiella procera* on pines in Minnesota. Plant Disease 66:260-261.

Verticicladiella procera was isolated from diffuse black streaking in roots of eastern white pine (*Pinus strobus*), red pine (*P. resinosa*), and for the first time from Austrian pine (*P. nigra*). The fungus appears to be no threat to trees growing on good sites in Minnesota.

Verticicladiella procera Kendrick, the cause of white pine root decline (1), has not been reported in Minnesota. The principal host of the fungus is eastern white pine (*Pinus strobus* L.) (1,5,8,10). Other recorded hosts include *P. resinosa* Ait. (8,10), *P. banksiana* Lamb. (3), *P. taeda* (5), *P. contorta*, *P. ponderosa*, and *Pseudotsuga menziesii* (6). This paper reports the occurrence of *V. procera* in association with other diseases and insects on pine in Minnesota.

MATERIALS AND METHODS

The eastern white pine trees examined in the study were located at the Cloquet Forestry Center (Carlton County, MN), University of Minnesota College of Forestry. The total basal area for the stand was 25.3 m^2 ha. The living white pine component of the stand was 21.6 m^2 ha, with the remaining basal area consisting of red pine and jack pine (*P. banksiana*). In the 3-ha stand, thirteen white pine had crowns with yellow or bright red needles, probably dying within the previous year. The basal area of these trees was 0.15 m^2 ha, 0.7% of the basal area of living white pine. The diameters at breast height (DBH) of the living and dead white pine were 26.3 and 20.6 cm, respectively. The average age at DBH of the live pine was 40.4 yr, and the average height was 21.5 m. The site index for the stand is 18 m for 50 yr (2), a good site for growing eastern white pine (9).

Five of the recently killed white pine, randomly selected, were cut and the boles examined for white pine blister rust (*Cronartium ribicola* J. C. Fischer ex Rabh.) and insects. The root collar and the proximal 1 m of the primary roots were exposed and examined for diseases and insects. Chips of wood from roots with discolored wood were placed in petri dishes with 2% malt agar and incubated at room temperature.

Isolations were also made from discolored roots of two dying eastern white pine and three red pine (*P. resinosa*) in Washington County and two Austrian pine (*P. nigra* Arnold) in Sherburne County. The red pine were on a poorly drained site, and the Austrian pine and eastern white pine were on hillsides. The crowns and boles of these trees were examined for other diseases and insects.

RESULTS

Verticicladiella procera was associated with diffuse black streaking in roots on four of five trees sampled in the Cloquet stand. Successful isolations only resulted from taking wood chips at least 1 cm below the root surface. *Armillariella mellea* (Vahl) Karst. mycelial fans and rhizomorphs were found on all five trees. White pine blister rust cankers girdled the stems at the base of the crown on all five trees. Weevils (*Pissodes* spp.; Coleoptera: Curculionidae) had colonized the roots on four trees from which *V. procera* was isolated. Adult *Pissodes* were emerging from three trees. In the fourth tree, *Pissodes* adults were laying eggs. In the stems of all five trees were larvae of roundheaded borers (Coleoptera: Cerambycidae). Galleries and emerging adults of *Ips* species (Coleoptera: Scolytidae) were found on two trees.

Verticicladiella procera was isolated from roots of the two eastern white pine in Washington County, one of the red pine, and one of the Austrian pine. *Pissodes* spp. and a brown cubical decay were also found in the eastern white pine roots. The needles of the Austrian pine were heavily infected with *Dothistroma pini* Hulb., and *Ips* spp. were found in the boles of the Austrian pine and red pine.

DISCUSSION

In the Cloquet stand, *V. procera* was associated with different symptoms and host characteristics than previously described (1,8,10). The white pine were older (61 vs. 3–20 yr) and did not have basal cankers with the dark stained, resinous wood characteristically found with the fungus in other areas. Eastern white pine with *V. procera* and basal cankers are usually associated with

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poorly drained sites, whereas our isolations of *V. procera* were from white pine growing on a good site. In the situation reported here, however, the trees were suffering from other problems. White pine blister rust probably predisposed the trees to attack by *A. mellea*, *V. procera*, and the insects. This relationship of blister rust, *A. mellea*, *Verticicladiella* sp., and insects was similar to one described for western white pine (*Pinus monticola*) (4).

Despite the presence of the various pathogens in the Cloquet stand, eastern white pine was growing well. The stand has good stocking (7) and has lost less than 1% of the total eastern white pine basal area in the past year.

Verticicladiella procera was found on eastern white pine in two distant locations in Minnesota, and it is probably widely distributed. This pathogen appears to pose no threat to trees growing on good sites. On poor sites, *V. procera* may become a problem as it has in other states. The presence of this pathogen on red pine and Austrian pine appears to be of little significance in Minnesota. As far as we are aware, this is the first record of *V. procera* on Austrian pine. This host was infected with *D. pini* and attacked by *Ips*, which probably contributed to the death of the tree.

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Cleistothecia of *Sphaerotheca macularis* on Strawberry Plants in Florida

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ABSTRACT

Howard, C. M., and Albregts, E. E. 1982. Cleistothecia of *Sphaerotheca macularis* on strawberry plants in Florida. Plant Disease 66:261-262.

Cleistothecia of *Sphaerotheca macularis* were found in 1981 for the first time on strawberry plants in Florida. They were found only on plants that had been grown in Maine and Michigan and were transplanted into Florida fruit production fields. Benomyl and sulfur failed to control powdery mildew on these plants. Powdery mildew was widespread on plants that had been grown in five other states, but no cleistothecia were found on these plants, and benomyl or sulfur controlled the disease.

Additional key words: *Fragaria* × *ananassa*

Powdery mildew of strawberry, caused by *Sphaerotheca macularis* (Wallr. ex Fr.) W. B. Cooke (*S. humuli* (D.C.) Burr.), has been reported from most areas of the world where strawberries are grown. Although the disease is widespread, the cleistothecial stage of the fungus has seldom been found (8). Khan (7) and Peries (8) reported that cleistothecia were found only on plants in the greenhouse in England. Cleistothecia have been reported on plants in the field in France (3) and in Canada (4,6). They have been reported in the United States only once before (1), even though the conidial stage is common in most areas of this country.

The conidial stage of powdery mildew was first reported in Florida in 1962 on plants of *Fragaria chiloensis* that had been imported from Belgium (2). Since 1967, the disease has occurred sporadically in Florida. In some years, little or no powdery mildew is found; in other years, it is widespread and relatively severe until control measures are taken.

In January 1981, abundant cleistothecia in various stages of development were found on leaves and fruit pedicels of Tufts strawberry plants that had been produced by Florida growers in nurseries in Maine and Michigan and were transplanted into fruit production fields in Florida in October 1980. The conidial and cleistothecial stages of powdery mildew persisted in these fields until hot, dry weather occurred in early March.

According to the growers, mildew was present on the plants before they were dug from the Maine and Michigan nurseries. Because the cleistothecia observed in January and February 1981 were on leaves and buds produced after the plants were set into Florida fruit production fields, they obviously developed in Florida. No cleistothecia were found on plants that had been grown in nurseries in Florida, North Carolina, Tennessee, Arkansas, or California, even though powdery mildew was widespread on these plants in November and early December 1980 and recurred in a few of these fields in February 1981.

During the 1980–1981 season, as in past years, powdery mildew was completely controlled by two to four applications of sulfur (2.2–5.6 kg/ha) or benomyl (.56 kg/ha) at 4- to 7-day intervals, except on plants from Maine and Michigan. Powdery mildew was not controlled on the Maine and Michigan plants even in fields that received 10–12 applications of benomyl plus five applications of sulfur. Even some of the fruit on these plants became infected. Infected green fruit became bronze or brownish, and a network of very fine, shallow cracks developed in the epidermis. The cracks could be seen only with the aid of a hand lens. As the infected fruit ripened, the cracks widened, and the fruit turned reddish brown and had a dull, dry appearance.

Horn et al (5) reported that severely

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