

cm) were unaffected, snow depth records identify mid-February to mid-March as the window for the major freeze event. Similar and widespread damage to red spruce also occurred during the winter of 1948 (Curry and Church, J. For. 50: 114-116). The unique feature of both these events was the occurrence of two consecutive days of rapid temperature drop from above to well below freezing (but well above the reported critical freezing temperature).

## A184

PURIFICATION AND CHARACTERIZATION OF AN ENDOPOLY GALACTURONASE FROM *CRYPTHONECTRIA PARASITICA*. S. Gao and L. Shain. Dept. Plant Pathology, Univ. of Kentucky, Lexington, KY 40546-0091.

An extracellular endopolygalacturonase (E.C.3.2.1.15) was purified to apparent homogeneity from culture filtrates of *Cryphonectria parasitica* strain Ep 155 grown with 1% sodium polypectate as an inducer in complete medium (Puhalla and Anagnostakis 1971, Phytopathology 61:169-173). Purification involved ultrafiltration, cation exchange chromatography on CM-cellulose, and gel filtration on Sephadex G-75. The molecular weight was approximately 41 kDa as estimated by SDS-PAGE and gel filtration. The pI of the enzyme was about pH 7.9 and it had a pH optimum of 5.0. The temperature optimum was 40 C. The enzyme acted in an endo fashion; a 50% reduction in viscosity of polygalacturonic acid resulted in fewer than 5% hydrolysis of the glycosidic bonds.

## A185

*TRICHODERMA HAMATUM* AND *T. HARZIANUM* VS. *PHYTHIUM* SPP. IN STORED LONGLEAF SEEDLING ROOT SYSTEMS. Xiaolan Sun<sup>1</sup>, J.P. Jones<sup>1</sup>, and J.P. Barnett<sup>2</sup>. <sup>1</sup>L.S.U. Agric. Center, La. Ag. Expt. Ctr., Baton Rouge, LA 70808 and <sup>2</sup>U.S.D.A. Forest Service, So. For. Expt. Stn., Pineville, LA 71360

*T. hamatum*, *T. harzianum*, *T. pseudokoningii* and *T. koningii* were the common species of *Trichoderma* associated with longleaf seedling roots cold-stored 4 wks. Of 1000 *Trichoderma* isolates tested, 292 were able to grow well at 4°C. Through a dual culture technique, 64 of these were determined to be antagonistic to 14 *Pythium* isolates which were pathogenic to newly germinated slash pine seeds in petri dishes. The 14 *Pythium* isolates and 4 *Trichoderma* species were inoculated on pine seedlings which were then cold-stored for 4 weeks. After storage the seedlings were outplanted; those inoculated with *Pythium* suffered relatively high levels of mortality while those inoculated with *Trichoderma* had very high survival rates. The results confirmed that *Pythium* spp. are one cause of pine seedling loss during cold storage and that some *Trichoderma* isolates may be useful for biocontrol of this disease. Field studies are being implemented to evaluate the potential of *Trichoderma* for the biological control of seedling mortality of southern pine during cold storage.

## A186

EVALUATION OF CYPROCONAZOLE FOR CONTROL OF FUSIFORM RUST ON LOBLOLLY PINE SEEDLINGS. W.A. Carey and W.D. Kelley. School of Forestry, Auburn University, AL 36849-5418.

Cyproconazole seed treatments and foliar sprays each protected loblolly (*Pinus taeda* L.) seedlings from fusiform rust (causal agent *Cronartium quercuum* (Berk.) Miyabe ex Shirai f. sp. *fusiforme*). In laboratory tests (controlled inoculations), cyproconazole seed treatments at rates of 1.25 and 2.5 g ai/kg seed were effective for at least 20 and 30 days, respectively, after sowing; foliar sprays at rates of 84 or 112 g ai/ha were effective for 14 but not 21 days after application. In nursery trials (natural inoculation), no seedlings receiving only foliar applications of cyproconazole (four applications at test rates of 56, 84, and 112 g ai/ha) were galled at lifting, and only 0.1% of seedlings receiving only the seed-treatment (1.25 g ai/kg seed) were galled. At lifting, 54% of seedlings in non-treated control plots in the field study were galled. Neither seedling heights, diameters, dry weights, nor mycorrhizal development differed among treatments.

## A188

INCIDENCE AND SEVERITY OF BUTTERNUT CANKER IN WISCONSIN IN 1976 AND 1992. Jane Cummings Carlson, Mark Guthmiller, Department of Natural Resources, 3911 Fish Hatchery Rd., Madison, WI 53711.

Butternut, *Juglans cinerea* is being examined for listing as a threatened or endangered species. Its demise is caused primarily by a fungus, *Sirococcus clavigenanti-juglandacearum*. Butternut canker was first reported in Wisconsin in 1967. In 1976, 2,882 trees on 83 plots in 36 counties were examined; 31% and 9% of the trees surveyed were found to be cankered and dead, respectively. In 1992, 32 counties were resurveyed to determine disease incidence, severity, spread, and impact on reproduction. Of 1,394 trees surveyed, 92% were cankered and 27% dead. Reproduction was frequently affected; 65% of the sprout clumps and 75% of the seedlings were cankered. Apparently disease resistant individuals were rare. Butternut canker was observed in 18 of 36 counties in 1976 and in all 32 counties surveyed in 1992. Rare, noncankered butternut > 10" in diameter is currently being used for preservation of genetic material. Silvicultural techniques are being applied to encourage reproduction of butternut.

## A189

PATHOGENICITY OF 3 DECLINE FUNGI ON WATER-STRESSED CORK OAK. K. A. Jacobs<sup>1</sup>, C. Colinas<sup>2</sup>, I. F. Alvarez<sup>3</sup>. <sup>1,3</sup>Dep. Patol. Veg., IRTA, 08348 Cabrils, Spain, <sup>2</sup>ETS Eng. Agr., Univ. Llerida, 26006 Llerida, Spain.

Two hundred cork oak seedlings were divided into two treatments: well-watered, and watered every 10-20 days. When mean leaf water potentials of the low water treatment were maintained at -2.0 MPa for 8 wks, stems were inoculated with mycelial agar plugs of *Botryosphaeria stevensii*, *Hypoxyton mediterraneum*, *Coryneum* sp., or agar alone. Rate of symptom development was monitored, and shoot growth and canker size were measured after 6 wks. Shoot death occurred in nearly all seedlings inoculated with *B. stevensii*, but the rate of symptom development and death were not affected by the watering treatment. Water-stressed seedlings inoculated with *H. mediterraneum* developed significantly ( $p=0.01$ ) larger cankers (3.4 cm) than non-stressed plants (1.3 cm). *Coryneum* sp. was not pathogenic to seedlings from either watering treatment.

## A190

\* MORPHOTYPE AND WATER STRESS EFFECTS ON DISEASE DEVELOPMENT BY *SPHAEROPSIS SAPINEA* ON RED PINE. J.T. Blodgett and G.R. Stanosz, Dept. of Plant Path., Univ. of Wisconsin, Madison, WI 53706.

*Sphaeropsis sapinea* (syn. *Diplodia pinea*) causes a shoot blight and canker disease of pines and other conifers. Severe losses have been reported on trees predisposed by stresses, including drought. Two *S. sapinea* morphotypes ("A" and "B") are recognized and have been suggested to differ in virulence. A greenhouse study was conducted to compare the aggressiveness of "A" and "B" isolates on water-stressed and nonstressed red pine (*Pinus resinosa*). Three-year-old potted seedlings were either watered daily or when the mean predawn water potential fell below -1.64 MPa. Growing shoots were inoculated by placing a colonized agar plug on a wound made by removing a needle fascicle. Two "A" and two "B" isolates were used. After four weeks, "A" isolates caused more severe symptoms and could be recovered further from the inoculation site than "B" isolates (which produced less severe or no symptoms). "A" isolates also caused greater symptom development on water-stressed trees. Symptom development was positively correlated ( $R^2 = 0.90$ ) with distance of recovery from the inoculation point.

## A190a

A needle-cast disease complex in Southern pines. F.F. Jewell, Sr., School of Forestry, Louisiana Tech University, Ruston, LA 71272.

Since 1985, periodic observations and collections have been made of fungi associated with needle-cast symptoms on the four major Southern pines in Alabama, Florida, Louisiana, and Texas. The prominent fungi observed (anamorph and/or teleomorph) were *Lophodermella cerina*, *Lophodermium australe*, *Plodioderma lethale*, and *P. hedgcockii*. Similar patterns of seasonal symptom appearance were observed regardless of geographic locality. *L. cerina* was usually the earliest needle cast observed, with the affected foliage a bright red, which continued until casting (coined "red needle cast"). Characteristic symptoms of *L. australe*, *P. lethale*, and *P. hedgcockii*, which normally appeared >3-5 weeks later than *L. cerina*, initially appeared reddish then tan to tan/grey prior to casting (grey needle cast). Seldom was *L. cerina* observed simultaneously with the other pathogens on an individual host. *L. australe*, *P. lethale*, and *P. hedgcockii* were observed both individually or in various combinations on affected foliage of host pines.