jected *C. japonicum* seed to a factorial combination of moist stratification and exposure to light. Two seed lots were obtained from the Arnold Arboretum of Harvard Univ., accessions 1150-67 and 882. Half of the seeds in each lot were moist stratified in petri dishes on filter paper for 8 days at 3.5°C. All seeds then were germinated at 25°C with either a daily photoperiod of 15 hr or complete darkness. Those samples not exposed to light were placed in a light-tight container. Germination was defined as the average percentage of seeds per treatment combination that showed the emergence of a radicle. Unstratified seeds germinated at 44.7% over both seed lots. Moist stratification increased germination to 92.0% and 56.7% for 1150-67 and 882, respectively. Light did not affect germination for either seed lot. Optimal seed germination conditions for *C. magnificum* will be determined in future studies. We have shown that moist stratification of katsura seeds improves germination and recommend this method as a means of promoting seed germination.

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Temperature and Light Effects on Germination of Burnet, *Sanguisorba* spp.

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Seeds of three *Sanguisorba* species native to Alaska were germinated in growth chambers with constant air temperatures of 5°, 10°, 15°, 20°, 25°, or 30°C and an irradiance of 150 $\mu M \cdot m^{-1} \cdot s^{-2}$ for an 18-hr photoperiod to identify optimum germination in relation to temperature and light. Four replicates of 100 seeds each were sown onto filter paper in petri dishes in each temperature treatment. At 20°C, four additional dishes per species were enclosed in foil to exclude light. Dishes were arranged at random by species in large clear plastic bags, and daily counts of radicle emergence were recorded. Germination of all three species was fitted to third-order polynomial equations by regression analysis. The predicted optimum germination temperature for *Sanguisorba officinalis* was 25°C; *S. menziesii* was 24°C; and *S. stipulata* was 25°C. Germination was most rapid (days to 50% germination) for each species in the 25°C treatment. *S. stipulata* did not germinate at 5°C, and both *S. stipulata* and *S. menziesii* showed less than 50% germination at 30°C. Seeds of all species germinated as well in darkness as in light.

51 POSTER SESSION 2G (Abstr. 122–126)
Low-temperature Stress–Woody Plants

122
A Study of Ice Nucleation and Propagation in Cranberry Plant using Infrared Video Thermography

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Infrared video thermography has recently been used to visualize ice nucleation and propagation in plants. At the UW–Madison Biotron facility, we studied the formation of ice in various parts of fruit-bearing cranberry (*Vaccinium macrocarpon* Ait.) uprights. The fruits were at the blush to red stages of ripening. Samples were nucleated at –1 or –2°C with ice-nucleating-active bacteria (*Pseudomonas syringae*). Following nucleation, samples were cooled to –6°C in ≈1 hour. The following observations were made: 1) When nucleated at a cut end, ice propagated rapidly throughout the stem and into the leaves at a tissue temperature of about –4°C. However, ice did not propagate from the stem through the pedicel to reach the fruit. During the 1 hour after ice propagation in the stem, the fruit remained supercooled. 2) Within the duration of the experiment, leaves could not be nucleated from the upper surface. Ice from the lower leaf surface did nucleate the leaf, and ice propagated from the leaf to the stem and other leaves readily. 3) Both red and blush berries could only be nucleated at the calyx end of the fruit. 4) Red berries supercooled to colder temperatures and for longer durations than the blush berries. 5) In support of our previous studies, red berries were able to tolerate some ice in their tissue. These observations suggest that: 1) The upper leaf surface and the fruit surface (other than the calyx end) are barriers to ice propagation in the cranberry plant; and 2) at later stages of fruit ripening the pedicel becomes an ice nucleation barrier from the stem to the fruit. This may contribute to the ability of the cranberry fruit to supercool.

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Inheritance of Low-temperature-induced Cold Acclimation Response in Blueberry

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Mode of inheritance of cold hardiness (CH) in woody perennials is not well-understood. This study was undertaken to determine the mode of inheritance and gene action of CH in blueberry (*Vaccinium* section *Cyanococcus*). Two testcross populations (segregating for CH) derived from interspecific hybrids of *V. darrowi* (drw) x *V. caesariense* (csr) were used. Plants were cold-acclimated by a 4-week exposure to 4°C. Bud CH (LT_{50}) was defined as the temperature causing 50% injury (visual) when subjected to controlled freeze–thaw. Results show that the drw and csr parents had an LT50 of –13° and –20°C, respectively. The F_1 population exhibited mean LT_{50} of –14.7°C. The csr and drw testcross populations had a mean LT_{50} of –18° (39 individuals) and –14°C (33 individuals), respectively. Individuals of each population were distributed between parental values with center of distribution skewed toward the testcross parent. Since individuals having LT_{50}s as same as the recurrent parents were present in each population of only 33–39 plants, data suggest that CH is determined by relatively few genes. To determine gene action, the estimates for various genetic parameters (calculated from joint scaling test) were used in generation means analysis to test various models. Results indicate that CH in blueberry can be best explained by simple-additive dominance model, whereas models including epistatic components did not satisfactorily explain the data.

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Hardiness and Ornamental Characteristics of Lacebark Elm Selections

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Numerous cultivars of lacebark elm (*Ulmus parvifolia*) have been introduced recently without adequate testing of their hardiness. A block of commercial cultivars plus numerous experimental numbers were established to observe differences in growth form, ornamental characteristics, and cold hardiness. Laboratory freezing tests were conducted from November to March over a 3-year period to determine acclimation and deacclimation to low temperatures. Stem sections approximately 5 cm long were sealed in test tubes and placed in a low-temperature programmable freezer maintained at 0°C. Samples were cooled by approximately 6°C per hour from 0 to –48°C and held for 1 h at each temperature. Samples were then removed, allowed to thaw at room temperature, and held for 7 to 10 days. Stem samples were sectioned longitudinally to observe browning in xylem and bark tissues. During the winter of 1995–96, no visible injury could be noted on trees in the field in spite of very dry, desiccating weather with temperatures reaching –23°C. Laboratory freezing tests indicated acclimation to –30°C by 18 Dec. 1995 on several cultivars. During warm periods in February, deacclimation occurred on many selections to –18°C, whereas others maintained a killing point of –30°C. Growth form, bark exfoliation, and fall color varied among cultivars.

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Genetic Study of Cold Hardiness in Rhododendron Populations

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Few genetic studies have been conducted on the inheritance of cold hardiness (CH) in woody plants. An understanding of the genetic control of CH can greatly assist the breeder in reducing winter injury. This study was initiated to evaluate the distribution of CH phenotypes in segregating populations of evergreen rhododendrons. Naturally acclimated leaves from individual plants (parents, F_1 and 47 F_2 progeny) were subjected to controlled freeze–thaw regimes. Using slow cooling rates, leaf discs were cooled over a range of treatment temperatures from –10°C to –52°C. Freezing injury of leaf tissue was assessed by measuring ion-leakage and non-linear regression analysis (data fitted to Gompertz functions) was used to estimate T_{max}, the temperature causing the maximum rate