

rotations are precluded. Thinnings can salvage potential mortality, reduce competitive stress, and lower risk of southern pine beetle attack. Ground surveys on a 7-to 10-year cycle are recommended.

**G. Remove high-risk trees.** Severely affected trees are hazards to people when they occur around recreation sites. They also are hazards to neighboring trees because they attract southern pine beetles. In forest stands, it may be profitable to remove affected trees, delaying final harvest in stands that are adequately stocked with healthy trees that are near the size threshold for higher value products (pulpwood to small sawtimber; saw-timber to large sawtimber). Presalvage cuts recover the volume in weak trees before it is lost to littleleaf disease or to the southern pine beetle.

**H. Thin.** The primary objectives of thinning are to reduce stress and southern pine beetle risk while promoting good growth on residuals. Although the distinction is solely a matter of terminology, we view thinning as a preventive treatment prescribed before symptoms develop. Salvage or presalvage treatments are prescribed after damage is apparent (see option G). Basal area limits are determined by management objectives, markets, and stocking.

**I. Manage species composition.** Changing the species composition can be effective in reducing future losses in stands where damage is occurring but harvest is not desirable. (Options B and C are closely related but are regeneration options.) Short-leaf pine is most susceptible, with loblolly somewhat less so. Practices that increase the components of loblolly and other resistant species, such as hardwoods, are desirable.

**J. Consider fertilization.** Where nontimber resource values are predominant (such as recreation sites, historic sites) or where potential timber values permit, fertilization may be justified. Increasing nutrient supplies forestalls symptom intensification and improves tree vigor. Diameter growth may be sufficiently improved over a short period, pushing tree diameters over a threshold to a higher value product and justifying the cost of fertilization. Formulations should include phosphorus, which stimulates root growth. One ton of 5-10-5 plus one-half ton of ammonium sulfate per acre have been recommended.

**K. Consider regenerating the stand.** Short rotations should be considered when symptoms appear on more than 25 percent of a stand before age 25-30. Regeneration is called for in sawtimber size stands when healthy stocking drops below 60 ft<sup>2</sup>. Stands in this condition are vulnerable to littleleaf disease and southern pine beetle losses. Mortality may exceed growth in the years ahead. Even when healthy stocking is adequate, the presence of symptoms may indicate a low vigor, which is an invitation to southern pine beetles. The risk of southern pine beetle losses must be weighed against future increases in product value.