SILVICULTURAL AND LOGISTICAL CONSIDERATIONS ASSOCIATED WITH THE PENDING REINTRODUCTION OF AMERICAN CHESTNUT

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Abstract—Traditional breeding for blight resistance has led to the potential to restore American chestnut (*Castanea dentata* (Marsh.) Borkh.) to Eastern United States forests using a blight resistant hybrid chestnut tree. With prospects of pending wide-scale reintroduction, restoration strategies based on ecological and biological characteristics of the species are needed. American chestnut was adapted to a relatively wide range of site conditions, has the ability to persist under shaded environments yet respond quickly to release, and exhibits rapid growth and competitive ability. These characteristics are discussed in reference to potential for hybrid chestnut regeneration to spread into adjacent forest stands. The use of a hybrid for American chestnut reintroduction may prompt a variety of ecological concerns. Additionally, it is likely that many hybrid chestnut plantings will result in introduction of hybrid chestnut to areas outside its original range. Limitations in genetic fitness, potential for mutation of the blight pathogen, and threats from other exotic pests and pathogens will serve as continual barriers to chestnut restoration.

INTRODUCTION

American chestnut (*Castanea dentata* (Marsh.) Borkh.) was once a dominant tree species in the forests of Eastern North America, though the species was essentially eliminated as a canopy tree following the introduction of the chestnut blight fungus, *Cryphonectria parasitica* (Murr.) Barr. A dedicated breeding program, sponsored in large part by the American Chestnut Foundation, has made rapid progress toward producing a blight-resistant hybrid chestnut tree for restoration. This hybrid tree with be approximately 94 percent American chestnut and 6 percent Chinese chestnut (*Castanea mollissima* Blume), and is expected to be nearly indistinguishable from the American chestnut tree (Hebard 2006). With increasing optimism toward initiating a large-scale reintroduction program in the foreseeable future, it is important to address additional considerations unrelated to the blight resistance breeding program. This paper summarizes issues presented in much greater detail in Jacobs (2007).

ECOLOGY AND SILVICS OF AMERICAN CHESTNUT

Because chestnut blight has been prevalent since the early 1900s, relatively little is known about the biological and ecological attributes of American chestnut compared to other common forest tree species. There has been a recent movement, however, toward enhancing this knowledge through new experimental studies as well as examination of historical patterns of occurrence. American chestnut was often found in high abundance on upland habitats composed of non-calcareous, acidic to moderately acidic, and moist but well-drained sandy soils (Abrams and Ruffner 1995, Russell 1987, Stephenson and others 1991). It was formerly assumed that American chestnut occurred infrequently in ravines or valleys, but a recent survey reported that the species occupied 25 to 40 percent of the basal area in pre-blight stands of sites sampled in riparian zones in the southern Appalachians (Vandermast and Van Lear 2002). This suggests that American chestnut was adapted to a relatively wide range of site conditions.

American chestnut responds positively to high light conditions compared with co-occurring species (Latham 1992, King 2003). The species can apparently survive, however, for extended durations under shade (Latham 1992, McCament and McCarthy 2005, Paillet and Rutter 1989) and respond vigorously following release through disturbances that create canopy gaps (McEwan and others 2006, Paillet 2002, Paillet and Rutter 1989). This evidence suggests that American chestnut is an intermediate to tolerant species with regard to ability to survive under prolonged shading (McCament and McCarthy 2005, Wang and others 2006).

With regard to growth rates, historical literature suggested that American chestnut is highly competitive and fast growing during early development. These contentions have been confirmed in recent years, with reports of diameter growth rates approximating 5 mm per year in plantations and natural stands, with maximum values around 10 to 12 mm per year (Jacobs and Severeid 2004, McEwan and others 2006, Paillet and Rutter 1989).

PLANTING STRATEGIES FOR AMERICAN CHESTNUT RESTORATION

Recent studies have suggested underplanting (Wang and others 2006) or thinning and burning (McCament and McCarthy 2005) for reforestation of hybrid chestnut. It is also likely that afforestation (i.e., planting in former agricultural fields or pastures) will be an important target for hybrid chestnut plantings.

It is possible that a similar sequence to that reported by Paillet and Rutter (1989) could help to promote regeneration of hybrid chestnut into adjacent forests following afforestation plantings. Under this scenario, hybrid chestnut trees would be established in afforestation plantings (fig. 1). After reaching reproductive age, seed could then be disseminated into adjacent forests and along edges where pioneer trees could become established as canopy gaps were created (fig. 2). These trees would produce more seed as they continued to develop and a large pool of advance regeneration could

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Figure 1—American chestnut afforestation planting.

eventually be released through disturbance. This would lead to dominance of hybrid chestnut in the succeeding stand (fig. 3). Because of the high capacity of American chestnut to vigorously stump sprout (fig. 4), hybrid chestnut regeneration is likely to maintain itself or increase in volume following cutting or other disturbance.

Figure 2—Establishment of American chestnut tree along forest edge.

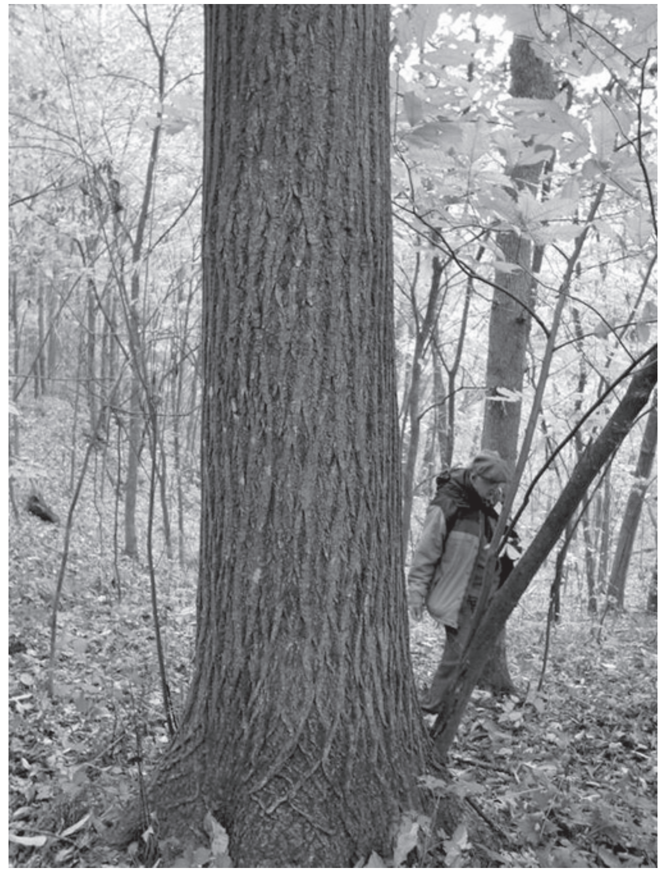

Figure 3—Large established American chestnut tree resulting from regeneration of pioneer tree.

PENDING CHALLENGES TO CHESTNUT RESTORATION

Many pending barriers to successful American chestnut restoration are likely to be encountered. Because hybrid chestnut is not pure American chestnut, some groups are likely to oppose planting these hybrid seedlings under the auspices of American chestnut restoration. This is most likely to be a factor under public land management, but could also

Figure 4—American chestnut sprouts from cut stump.

have some implications associated with governmental cost-share programs on private lands. On reforestation sites on public lands, social resistance to harvesting may limit the ability to create large canopy openings that are most likely to promote vigorous growth of planted trees.

There are also threats from various exotic insects and pathogens other than the chestnut blight fungus. *Phytophthora cinnamomi* Ronds, an introduced soilborne oomycete probably poses the greatest concern at present, and may necessitate site selection as well as further resistance breeding (Rhoades and others 2004). Other possible threats include the Oriental gall wasp (*Dryocosmus kuriphilus* Yasumatsu), Gypsy moth (*Lymantria dispar* L.), and ambrosia beetles (*Xylosandrus crassiusulus* Mot. and *X. saxeseni* Blandford).

Regarding deployment, it is likely that early hybrid chestnut restoration plantings will be limited by quantities and cost of blight-resistant seed and seedlings. Furthermore, repeated testing will be needed to verify blight resistance and American chestnut phenotype in the early hybrid sources. The long-term genetic adaptability and maintenance of genetic variation in the current hybrid sources, which use a relatively narrow range of genotypes, is another factor that will need to be critically assessed. Finally, when blight-resistant hybrid chestnut seedlings are released, it will be difficult to ensure that plantings are limited to areas representing the original American chestnut range. Many of the areas where hardwood afforestation planting programs are most active are outside of the primary American chestnut range (i.e., the Midwestern United States or the Lower Mississippi Alluvial Valley).

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