Figure 1. The two black cherry trees in this photo are in a mesic hardwood forest in southeast Wisconsin dominated by sugar maple. These trees show the black cherry's dark, scaly bark and long, branchless boles in a heavily shaded environment. The tree on the left has scalier/shaggier bark than typical black cherry. Photo by Nicholas LaBonte, USDA Forest Service, 2023.

Black Cherry: Guidance for Seed Transfer Within the Eastern United States

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Abstract

Black cherry (*Prunus serotina* Ehrh.) is a shade-intolerant hardwood tree that is found occasionally to frequently in a variety of hardwood forest types across the Eastern United States and extreme southeastern Canada, as well as parts of Mexico. Valued for its colorful, dense, and highly workable wood, black cherry is also a notable source of soft mast for wildlife. Black cherry regenerates readily on disturbed sites when adequate seed crops are present. In the heart of its commercial range, however, well-documented regeneration problems occur due to complex and unique circumstances. Black cherry has high genetic diversity due to high levels of seed dispersal and pollen flow, while population structure is low. Common garden studies revealed that black cherry is somewhat more sensitive to seed transfer than some other hardwoods with similarly expansive ranges and high genetic diversity. Seed-transfer distances of 200 to 300 miles (322 to 483 km) from south to north, or approximately 3 degrees latitude northward, is considered a safe recommendation to maximize growth. Black cherry is affected by a variety of native damaging insects and fungal diseases that reduce its economic value. Under climate change, black cherry is likely to expand its range northward but may suffer from increased stress and insect attacks in parts of its range.

Introduction

Black cherry (*Prunus serotina* Ehrh.) is a medium-to-large, early-successional hardwood tree that grows on a variety of well-drained soils throughout the Eastern United States, usually as a minor component of mixed hardwood forests. It grows best on well-draining, rich, loamy, or sandy soils (Marquis 1990), although it is often found in old field environments with degraded, rocky, sandy, or clay soil. On suboptimal sites, black cherry rarely attains commercial size or form. The species is considered shade intolerant;

although its seedlings can persist for years in shade and respond to release (Auclair and Cottam 1971), they are not competitive with more shade-tolerant species in partially shaded growing conditions (Marquis 1979). A mature black cherry's very dark, scaly, "burnt potato chip" bark is distinctive (figure 1). Black cherry produces racemes of small, mildly fragrant white flowers in late spring or early summer (figure 2) that mature into small, dark purple drupes in early fall (figure 3). Leaves and twigs have a distinctive bitter almond or cherry scent due to cyanogenic glycosides, including amygdalin (Telichowska et al. 2020).

Black cherry is sympatric with several other native *Prunus* species in different parts of its range along with commonly cultivated *Prunus* species (e.g., peach, plum, cherry, and apricot) introduced from Europe and Asia. It is only distantly related to the sympatric native pin cherry (*Prunus pensylvanica* L. f.) and the widely planted domestic stone fruits (Shi et al. 2013). Hybridization has not been documented with these species or the more closely related sympatric chokecherry (*Prunus virginiana* L.), which is a thicket-forming shrub.

Black cherry's glacial refugia are not entirely clear. Its broad current distribution in Mexico indicates that it was able to migrate south quite effectively as the climate cooled (Guzman et al. 2018, McVaugh et al. 1952), and it still occurs near a site in Texas where seed remains have been found in Pleistocene packrat middens (Van Devender 1979). Analysis of chloroplast DNA in its northern range hints at several refugia east and west of the Appalachian Mountains (Pairon et al. 2010). Its persistence in likely Pleistocene refugia indicates its potential to adapt to climate changes and migrate to nearby suitable habitats if necessary, although the Climate Change Tree Atlas identifies insects and diseases as potential complicating threats in the future (Peters et al. 2020).

Figure 2. Black cherry flowers can proliferate across eastern forests in the spring. Photo by Richard Gardner, bugwood.org.

Figure 3. Black cherry fruits (left) are a favored food source for birds in the Eastern United States. The leaves of black cherry (right) are relatively small in stature, but crowns produce dense shade during the active growing season. Photos by Franklin Bonner, USDA Forest Service (retired), 2010, and Steve Katovich, USDA Forest Service, 2019.

Black cherry will likely be able to expand its range in some areas given current evidence and its large native range, adaptability, and dispersal ability (Segura et al. 2018). In the areas where it is most abundant, however, black cherry may struggle to benefit from climate change due to other factors that are currently causing it to diminish in importance. In its core commercial range on the Allegheny Plateau, black cherry is a dominant canopy species (up to 50 percent of basal area in some areas) and produces large veneer logs and sawlogs more consistently in this area than anywhere else in its native range. Black cherry reproductive success has declined dramatically in these areas, however, due to plant/disease feedbacks at high densities and changes in nitrogen deposition rather than climate stress (Royo et al. 2021).

Genetics

Black cherry is a monoecious tetraploid (2n = 4x = 32) with a relatively small genome of 490 Mb (Jung et al. 2019). Its nectar-producing flowers are visited by a variety of generalist insects (McLaughlin et al. 2022), and ground-dwelling Andrenid miner bees seem to be the most important pollinators. Black cherry is primarily outcrossing and can generally be considered self-incompatible (Gordillo-Romero et al. 2020). Its fleshy fruits are eaten and dispersed in the digestive tracts of a variety of animals, and it is likely that birds are an effective means of long-distance seed dispersal. Black cherry apparently does not hybridize readily with its closest relatives, so hybridization is not a concern for seed movement considerations.

Studies of genetic structure in black cherry revealed weak differentiation among populations with relatively low F_{ST} (a measure of population differentiation) estimates using 8 nuclear microsatellite loci: 0.06 for trees sampled within the native range of black cherry and 0.09 for invasive populations in Europe (Pairon et al. 2010). A smaller study with five microsatellite markers found high heterozygosity (0.7 to 0.8) and slightly lower allelic richness (30 to 40 vs. 40 to 50 unique alleles observed) in western range limit compared with core range populations (Beck et al. 2014), which indicates high genetic diversity on the black cherry genome. A large study using 12 microsatellite markers and DNA from herbarium specimens found limited isolation by distance, indicative of high gene flow and limited genetic structure (Konrade et al. 2018). A microsatellite marker study of black cherry in South America, where it is introduced and naturalized, also showed high heterozygosity and low population differentiation (Guadalupe et al. 2015), although Ecuadorian populations likely only contain a subset of the genetic diversity found in native Mexican populations based on chloroplast haplotype analysis (Downey et al. 2000).

Seed-Transfer Considerations

A meta-analysis of common garden studies of five major hardwood species in the Northeastern United States found that black cherry was more sensitive to climatic variables than other species tested (red oak [*Quercus rubra* L.], black walnut [*Juglans nigra* L.], yellow birch [*Betula alleghaniensis* Britton], and red maple [*Acer rubrum* L.]), especially for mean coldest month and warmest month temperatures (Leites et al. 2019). This finding indicates that black cherry seed should not be moved as far north as some other native hardwoods for assisted migration because of heightened sensitivity to both cold winter and hot summer temperatures. The distinct morphology of black cherry subspecies from dramatically different climates (Guzman et al. 2018) indicates that locally adapted genetic strains of this species have developed despite pervasive gene flow. Local adaptation is probably less pronounced in the relatively homogenous Northeastern United States versus the arid-to-tropical, mountainous extreme south and west of black cherry's sprawling native range, but investigators have observed adaptive differences in black cherry from high and low elevations in the Appalachian Mountains (Barnett and Farmer 1980).

Table 1. Summary of silvics, biology, and transfer considerations for black cherry

Black cherry *(Prunus serotina)*	
Genetics	• Genetic diversity: high • Gene flow: high
Cone and seed traits	• Fleshy fruit with single seed • About 2,000 cleaned seeds per pound (4,000 per kilogram) • Can be stored in freezer or refrigerator 3 to 5 years if dried to 4 to 6 percent moisture
Insect and disease	• Eastern tent caterpillar and cherry scallop shell moth are major defoliators; peachtree borer and peach bark beetle attack stems • Vulnerable to generalist decay fungi; black knot fungus causes defects
Palatability to browse	• Not a preferred browse species, but browsing can be a problem when pressure is high and preferred species are absent
Maximum transfer distances	• Relatively sensitive to seed transfer: distances less than 200 mi (322 km) are safe • Use caution with transfers greater than 250 mi (402 km)
Range-expansion potential	• Black cherry is likely to expand in some areas due to excellent seed dispersal and decline in other areas where it is currently abundant due to stress from insects, diseases, and drought

In earlier studies, black cherry has showed strong site by provenance interactions and poor performance of sources that had been moved more than 5 degrees latitude north or south of the planting site (Carter et al. 1983, Genys and Cech 1975), which indicate a level of local adaptation. Sources from locations south of the planting site within 210 mi (338 km, or 3 degrees latitude) are generally strong performers (e.g., Walters 1985), although some sources from 350 miles (563 km, or 5 degrees latitude) south of the planting site may perform well. Sources from 200 to 250 miles (322 to 402 km)—3 degrees of latitude—south of the planting site will likely be the best performers at a given location, but moving sources farther than this is risky. Collections from parent trees with superior phenotypes do not necessarily exhibit significantly better performance than collections from average parent trees (Pitcher 1982).

Insects and Diseases

Many native insects and diseases affect black cherry. The species is a preferred food source of the eastern tent caterpillar (*Malacosoma americanum* F.), which can cause defoliation, reduced growth, and occasionally mortality due to repeated attacks (Marquis 1990). Cherry scallop shell moth (*Rheumaptera prunivorata* F.) can also cause defoliation. Black cherry is vulnerable to several stem borers that can damage the wood and leave distinctive pitch spots on the outer bark (Kulman 1964), including the peach bark beetle (*Phloeotribus liminaris* Harris), lesser peachtree borer (*Synathedon pictipes* Grote & Robinson), and cambium miner (*Phytobia pruni* Gross).

The most recognizable fungal disease of black cherry is black knot, caused by *Apiosporina morbosa* Schwein., which causes large, woody black swellings on stems and can destroy the timber value of trees. Leucostoma canker (*Cytospora leucostoma* [Pers.] Sacc.) is a fungus that causes cankers and branch mortality, often in association with cambium miner feeding (Gross 1967). Several species of generalist wood decay fungi, including *Armillaria mellea* (Vahl) P.Kumm. and *Laetiporus sulphureus* (Bull.) Murrill, attack the wood of mature black cherry trees. Due to its typical canopy position and somewhat weak branch structure, black cherry is often damaged by storms (figure 4). These injuries provide infection courts for decay fungi (Campbell and Davidson 1940, Downs 1938), although most wounds can be compartmentalized. Increased frequency of severe storms and ice storms in a changing climate could increase economic losses of black cherry due to these opportunistic native fungi.

White-tailed deer (*Odocoileus virginianus* Zimmermann) do not prefer black cherry as browse compared with many commonly co-occurring species (Sample et al. 2023), which allows black cherry to regenerate well (relative to other hardwoods) in areas with heavy browse pressure. Browsing can be a serious problem, however, in areas with high pressure where preferred trees are uncommon. Although the defensive hydrocyanic acid-producing compounds in the leaves are highly poisonous to cattle (Smeathers et al. 1973) and other livestock, deer and rabbits are either not as vulnerable to harm from these compounds or do not consume enough at one time to be harmed.

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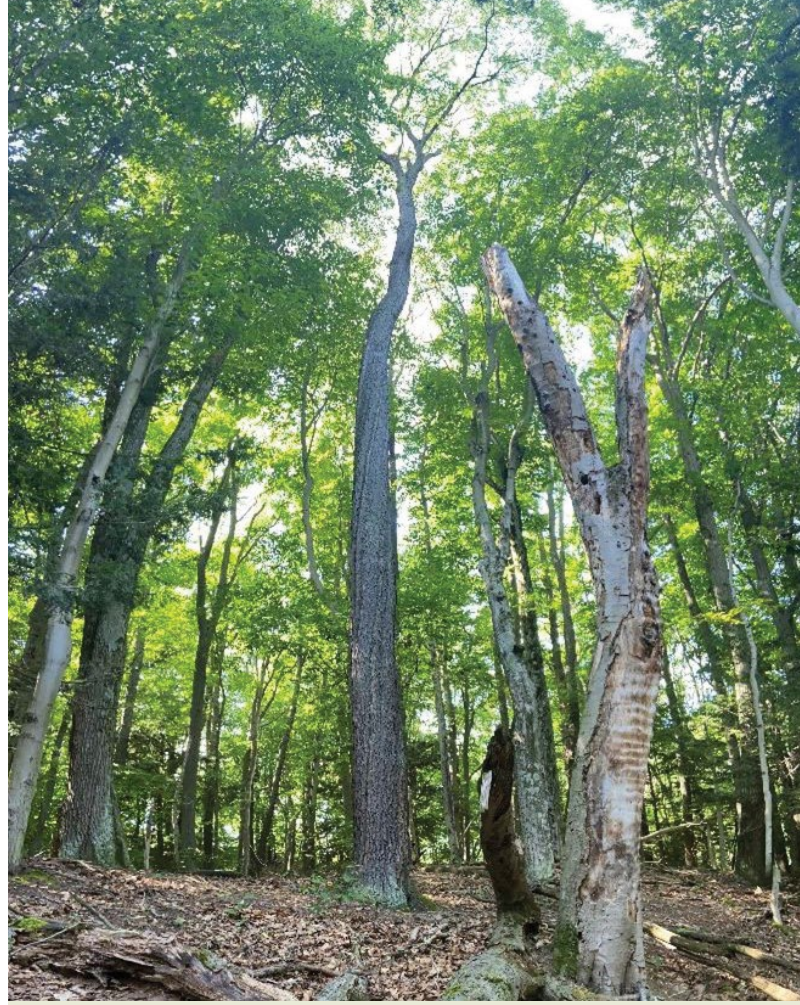

Figure 4. This large black cherry is growing in southwestern Michigan in a forest with deep, sandy soils. The forest is dominated by American beech (*Fagus grandifolia* Ehrh.), northern red oak (*Quercus rubra* L.), and eastern hemlock (*Tsuga canadensis* [L.] Carrière). This tree, growing among others with storm damage, demonstrates crown form and canopy position typical of good-quality stands in most of black cherry's range. Photo by N. LaBonte, USDA Forest Service, 2023.

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