Hackberry: An Alternative to Ash Species in the Battle Against Emerald Ash Borer

Tim Mathers

Superintendent of Nursery Operations, Toronto and Region Conservation Authority, Woodbridge, Ontario, Canada

Abstract

Emerald ash borer (*Agrilus planipennis* Fairmaire) is a pest that is spreading across much of the Northeastern United States and parts of southeastern Canada. Scientists, foresters, and land managers are dealing with its devastating effect in a variety of ways. One simple and effective method for controlling the pest is to plant a diverse array of native tree species that are resistant or immune to attack from this pest. Northern hackberry (*Celtis occidentalis* L) is comparable with most, if not all, of these regions' native ash species and is, therefore, suggested as a suitable alternative for these species.

Background

Eastern North America contains a number of native and introduced ash species. Southern Ontario and much of the Great Lakes region are home to five of these species, including white ash (*Fraxinus americana* L), green/red ash (*F. pennsylvanica* Fern), black ash (*F. nigra* Marsh), blue ash (*F. quadrangulata* Michx), and pumpkin ash (*F. profunda* [Bush] Bush) (Smith 2004).

At least two of these species, white and green/red ash, are cornerstones of many rural and urban landscapes found throughout these regions. Since its discovery in the Detroit, MI/Windsor, ON, area in 2002, however, emerald ash borer (*Agrilus planiplennis* Fairemaire) (EAB) has destroyed millions of native ash trees across several States and two Canadian provinces (figure 1) (Michler and Ginzel 2010). In fact, the speed and thoroughness of the devastation have not only affected the appearance of these landscapes, but they threaten their health and function as well. Without an effective long-term solution, the nature and severity of this outbreak have created a sense of urgency among researchers, governments, and the public.

Despite the fact that no effective control of EAB has yet been found, researchers and land managers are investigating several promising approaches, including the following:

- Chemical controls using a number of novel insecticides (Herms and others 2009, BioForest Technologies 2011, McCullogh and others 2011).
- Biological controls using an array of fungi, nematodes, and parasitic insects (Hajek and Bauer 2009, USDA APHIS/ARS/FS 2012).
- Genetic manipulation using Asian and North American populations of EAB (Bray and others 2011).
- Germplasm conservation (Simpson 2010).
- Silvicultural controls using harvesting prescriptions (Gupta and Miedtke 2011, Williams and Schwan 2011), aftermath natural regeneration (Herms and others 2011), the development of EAB-resistant hybrids between native and exotic ash species (Koch and others 2011), and planting alternative tree species that are resistant or immune to EAB attack (Cregg and Schutzki 2006).

An Interim Solution

Given the importance of ash trees to the health and functionality of urban and forest landscapes and the very real threat facing these trees, it is important that prompt actions be taken in response to EAB. Failure to take action runs the risk of repeating past experiences, such as those that occurred as a result of chestnut blight, Dutch elm disease, and butternut canker. These epidemics have decimated populations of American chestnut (*Castanea dentata* [Marsh] Borkh), native elm species *(Ulmus americana* L, *U. thomasii* Sarg, and *U. rubra* Muhl), and butternut (*Juglans cinerea* L), respectively.

In light of recent decisions by many local governments to restrict or ban planting of ash species, one of the easiest and most effective actions that homeowners, landowners, and tree planting agencies can take is to plant a diverse array of trees, particularly species that are resistant to diseases and insect infestations like EAB. Although this tack may not affect the ultimate fate of native ash species, it will help to maintain the health and functionality of the associated landscapes. It may also buy some time until a more effective solution can be developed.

One of the many species that can assist in this endeavor is common, or northern, hackberry (*Celtis occidentalis* L).

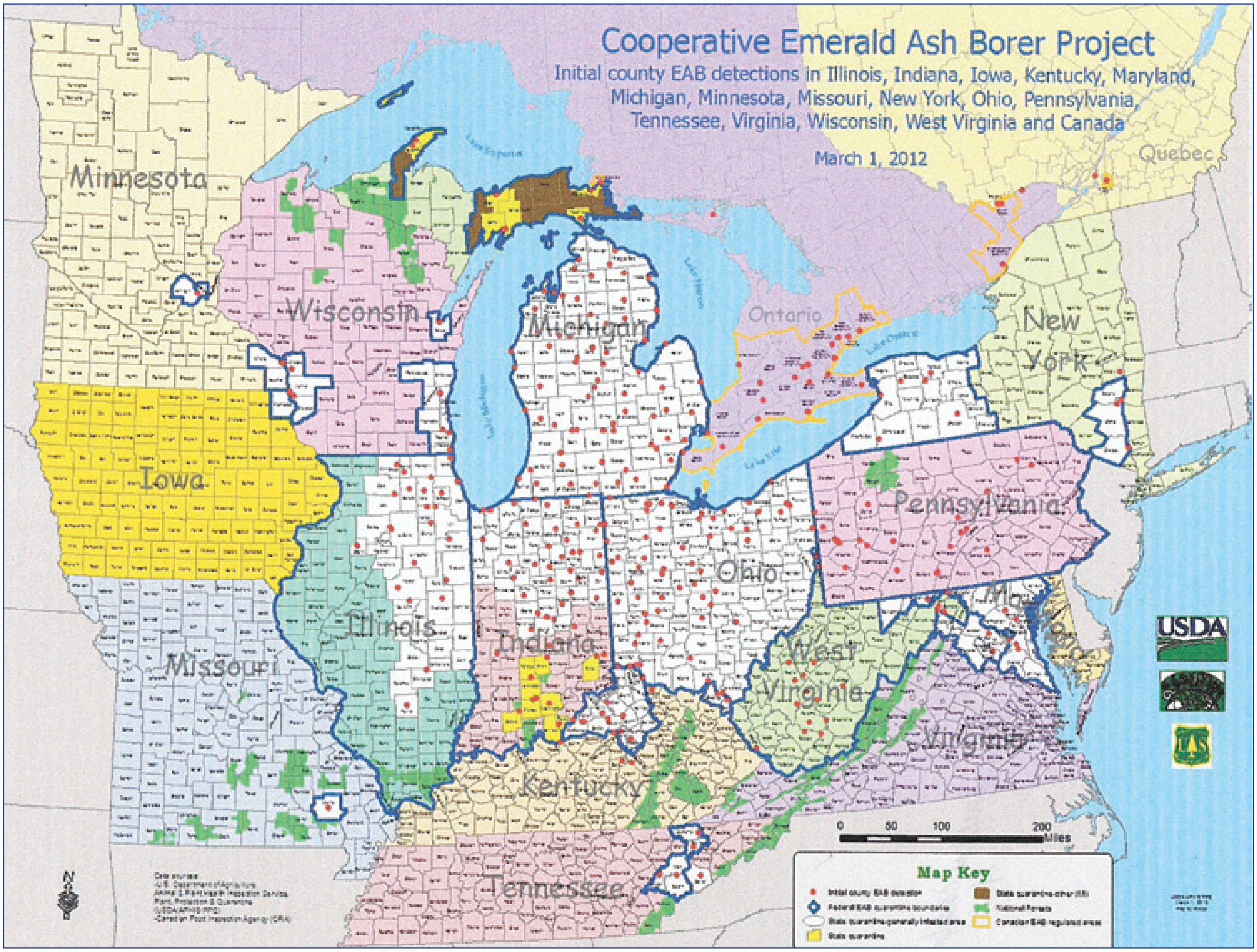

Figure 1. The spread of emerald ash borer across northeastern North America. (Map source: http://www.emeraldashborer.info, March 2012).

Species Description and Attributes

Northern hackberry is a relatively fast-growing and shade-tolerant member of the elm family (figure 2**)**. It is a native, deciduous tree that can live up to 200 years and grow to more than 65 ft (20 m) in height. Characteristically, it has an upright form with ascending branches, dark green foliage, and attractive bark. It produces regular crops of small cherry-like fruit that turn dark blue or purple when ripe.

Northern hackberry has a large geographic range, most of which is in the eastern part of the United States (figure 3). In southern Ontario, it is at the northern extremity of this range within the deciduous forest region (or Carolinian zone). Interestingly, some evidence shows that northern hackberry is a relatively recent and expanding arrival to this zone (Waldron 2003). Although northern hackberry in Ontario is found primarily in the deciduous forest region (seed zones 37 and 38, figure 4), several other local, but disjunct, populations are found throughout the central (seed zone 34) and eastern parts of southern Ontario (seed zone 36) and southeastern Quebec (Krajicek 1965). In addition, there is an isolated population at the southern end of Lake Manitoba (figure 3)**.**

Given this wide distribution, northern hackberry is found on a broad range of sites and soils. It is typically a bottomland species, although it is also found on upland sites. It grows best on moist, limestone-based soils near stream banks and along flood plains (Krajicek and Williams 1990). It also exhibits considerable hardiness (USDA hardiness zones 2 through 9) under the wide variety of climatic conditions found throughout its range (Anderson and Tauer 1993, Gucker 2011).

As a result of this adaptability, considerable genetic variation exists within the species, including several ecotypes (Krajicek 1965), as evidenced by variation in its form, size, and ability to withstand drought, cold, and periodic flooding (Bagley 1979, Tober and others 2011). In addition, given the

Figure 2. Typical form of an open-grown northern hackberry. (Photo by Tim Mathers, Toronto Region Conservation Authority [TRCA], April 5, 2012).

reproductive compatibility between northern hackberry and sugarberry (*Celtis laevigata* Willd) and dwarf hackberry (*C. tenufolia* Nutt), evidence shows that introgression with these species is possible where their ranges overlap (Boonpragob 1972, Wagner 1974).

Uses

Northern hackberry has been used historically in a number of interesting ways. In the Midwest and Plains States of the United States, it has been used extensively for windbreaks and shelterbelts to control erosion and blowing snow. Its fast growth and deep root system are excellent for providing quick cover and stabilization of disturbed soils (Gucker 2011).

As a wildlife species, northern hackberry has been used successfully as a food source and for cover. The fruit is highly sought after by a number of bird and mammal species, and it provides habitat for a variety of game species.

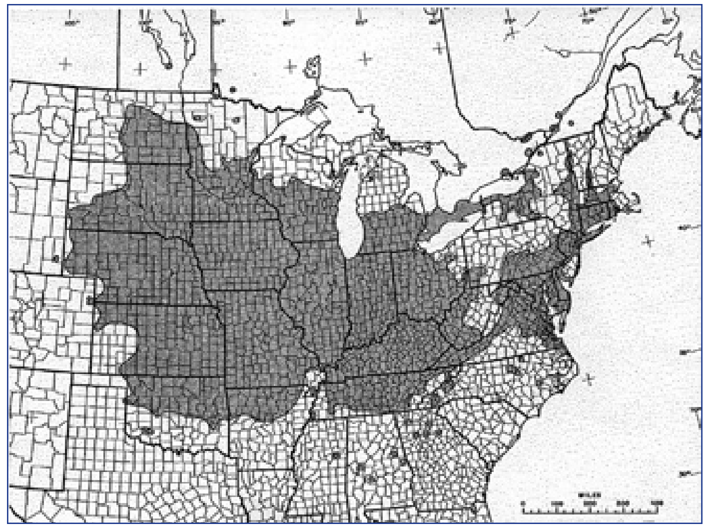

Figure 3. The native range of northern hackberry in North America. (Map source: Krajicek, 1965).

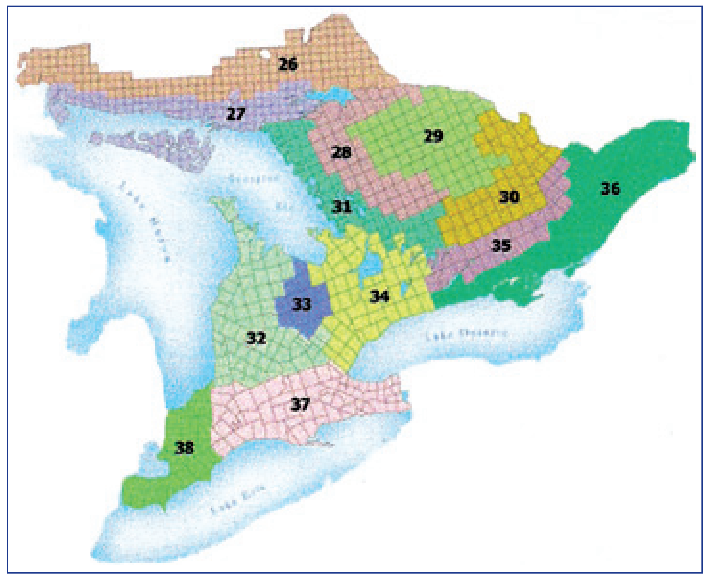

Figure 4. Seed zones for southern Ontario. (Data source: http://www.ontariosnaturalselections.org/ons8, July 21, 2012).

Northern hackberry has also been used for biomass production because of its fast growth, coppicing ability, and adaptability to a wide range of site conditions. In addition, it has been used for restoration and remedial work, particularly along watercourses and riparian zones, where fluctuating water levels and excessive competition can prove detrimental to other species.

In urban settings, northern hackberry is commonly used as a replacement for American elm in ornamental plantings and as a street tree. It functions well in these applications because of its hardiness, disease resistance (particularly to Dutch elm disease), transplantability, ease of propagation, and tolerance to shade, drought, soil compaction, and other urban environment stresses.

Limitations

Perhaps the greatest limitation to the use of northern hackberry is its susceptibility to a number of insect and fungal pests, including a variety of gall-making insects, leaf spot fungi, and witches' broom disease. Although many of these pests can make the tree look unattractive, their effects are more cosmetic than debilitating. In fact, with proper site, seed source, and/or cultivar selection, many of the unsightly effects of these pests can be overcome. The other difficulty with northern hackberry is its tendency to develop a low crown with poor branch structure (figure 5) which can lead to ice, snow, and wind damage. Fortunately, tree structure can be improved with corrective pruning, especially if it is undertaken within the first 5 to 7 years of the tree's life. Another option is to select seed sources from trees that exhibit good natural form and branch structure, or to select one of the several cultivars that have been developed for these and other traits, such as improved hardiness and greater pest resistance (Tober and others 2011).

Figure 5. Northern hackberry with branch structure needing corrective pruning. (Photo by Tim Mathers, TRCA, April 5, 2012).

Availability

Northern hackberry is available from a number of nurseries throughout southern Ontario and across the Eastern United States. Many commercial growers focus on larger caliper (machine-dug or container-grown) trees for the landscape and street tree markets. Other growers and forest and conservation nurseries produce smaller stock such as bareroot seedlings, transplants, whips (figure 6), or smaller container-grown seedlings for the restoration and reforestation markets.

Although no up-to-date production numbers exist, previous estimates indicated that production has been adequate for

Figure 6. Typical northern hackberry bareroot whip and container-grown planting stock. (Photo by Tim Mathers, TRCA, April 5, 2012).

market demands. For example, approximately 40,000 to 45,000 northern hackberry trees produced from 1995 to 2000 were able to satisfy southern Ontario market demands (Kessel 1994). With the liquidation of many existing ash inventories, however, (greater than 100,000 trees per year) anecdotal evidence indicates that, if northern hackberry is to be adopted as a substitute for EAB threatened ash species, production will need to increase accordingly (Swaile 2012). In fact, indications are that such increases are in progress, particularly for larger sized trees (for example, wire basket caliper and 2-, 5-, 7-, and 15-gallon container trees) (Llewellyn 2012).

If northern hackberry is to be a successful alternative to ash species, attention to seed sources and the origin of other types of propagating material will be critical (Anderson and Tauer 1993). To maintain species diversity and ecosystem health, it is important that plants be produced from locally adapted and identifiable sources of propagating material. This is particularly important in southern Ontario, where the scattered distribution of northern hackberry spans a variety of climate regimes, hardiness zones, and soil types. The Ontario Ministry of Natural Resources (OMNR) developed seed zones (OMNR 2011) (figure 4) for southern Ontario to assist in the collection and propagation of biologically appropriate seed and plant materials. In addition, cooperators from the Canadian Forest Service and the OMNR have developed a stock and seed transfer tool called Seedwhere (McKenney and others 1999, Nielsen 2003). This tool assists in making decisions regarding the appropriate movement of plant species from one seed zone to another. Both the seed zone map and Seedwhere have great value for current establishment of northern hackberry, as well as considerable potential in assisted migration efforts under various projected climate change scenarios (Pedlar and others 2011).

In addition, several hackberry cultivars have been developed for improved form and pest resistance, including Oahe, Magnifica, Prairie Pride, Chicagoland, and most recently, Prairie Harvest (Wennerberg 2004, Tober and others 2011). Most of these cultivars, however, have been developed from American propagating material for American conditions. This is not to say that these cultivars should not be used, where available, in southern Ontario. But, given the large geographic range of northern hackberry and the inherent variability in climate, soil, and site factors over its range, it is important to match conditions at the planting site with those of the seed sources, wherever possible (Anderson and Tauer 1993). Such an endeavor will not only help ensure greater survival and, therefore, better planting success, but it will also help maintain landscape diversity and functionality.

Final Thoughts

Because pests like emerald ash borer continue to spread across southern Ontario and the rest of eastern North America, they not only threaten the future of these areas' ash resource, but also negatively affect landscapes across these regions. To address this threat, governments, landowners, and environmental groups must develop workable and timely actions to deal with such threats. One of the most effective ways to accomplish this response is to plant a diversity of appropriate tree species. Such an activity is something that most people can and will embrace.

Although many species can be used as substitutes for ash, northern hackberry is a particularly suitable choice. Its compatibility with most, if not all, of southern Ontario's and eastern North America's ash species and its adaptability and availability to tree planters are seen as practical advantages for wider use.

Hopefully, with innovation and diligence, native ash species across their ranges can be restored and sustained. In the meantime, the time to plant more trees is now.

Address correspondence to:

Tim Mathers, Superintendent of Nursery Operations, Toronto Region Conservation Authority, 5 Shoreham Drive, North York, Ontario M3N 1S4, Canada; e-mail: tmathers@trca.on.ca; phone 416–661–6600, ext. 6401.

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