THE GLENWOOD ESTATE: OUR 32-YEAR EXPERIENCE USING ARBOTECT® 20-S TO CONTROL DUTCH ELM DISEASE

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Abstract.—We report a case study that demonstrates the successful use of the fungicide Arbotect® 20-S to protect American elms (*Ulmus americana*) from Dutch elm disease at a historic site in Charleston, WV. Standard injection protocols were used every 3 to 4 years to deliver the chemical into the root flares. Twelve of the original 16 trees remain 34 years after the initial treatment.

Introduction

Injection of trees with chemicals has been part of the tree care industry for several decades. A component of that technology has been control of vascular wilt diseases (especially Dutch elm disease [DED] and oak wilt) by injection of fungicides (Haugen and Stennes 1999). Over the decades, numerous chemicals have been tested for their efficacy in combating the pathogens that incite these diseases. It wasn't until systemic fungicides, particularly Arbotect 20-S® (thiabendazole; Syngenta Crop Protection LLC, Greensboro, NC) and Alamo® (propiconazole; Syngenta Crop Protection LLC, Greensboro, NC) were developed that acceptable levels of plant vascular disease control was achieved. This report is a case study that demonstrates the usefulness of chemotherapy to preserve high value individual elms.

Our initial efforts to use chemotherapy to control DED occurred in an effort to save several key American elms (*Ulmus americana*) on the West Virginia University (WVU) campus in Morgantown, WV. Initially, we attempted to use a form of the DuPont chemical Benlate® (benomyl) that we solubilized. At the time, this chemical was a widely used systemic fungicide, particularly for agricultural crops. Without much success, we turned to Arbotect 20-S when it became available and early tests by other researchers confirmed its promise as a control for DED. Colleagues at the West Virginia Department of Agriculture (WVDA) were aware of our DED control efforts at WVU. When WVDA was approached about the DED issue at the historic Glenwood Estate in Charleston, WV, they recommended to the board of the West Virginia College of Graduate Studies Foundation (then the controlling body for Glenwood), that we be contacted relative to DED problems. Thus started our three-plus decade of involvement with the Glenwood Estate elms.

The main home on the estate is a majestic Greek revival style mansion that was constructed in 1852 (Fig. 1) (Calwell 2014). The mansion was built on a 148 ha land parcel near the Elk River. The mansion was home to numerous families who figured prominently in the early history of the city of Charleston, WV. Their surnames, including Laidley, Summers, and Quarrier, are encountered today on numerous buildings and streets throughout the city. The original parcel of land functioned as a farm but over the years was subdivided and sold by owners during economic downturns. The mansion has undergone limited restorations over the years but essentially remains much as it did a century and a half ago, including the furnishings. Currently,

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Figure 1.—An early spring photograph of the Glenwood Estate in Charleston, WV. Photo by Brian Marr, used with permission.

the house sits on about 0.8 ha of land and is surrounded by residential neighborhoods. The estate was given to West Virginia College of Graduate Studies Foundation by Lucy Quarrier and Elizabeth Quarrier Hedrick with the intent that it be used for educational purposes. It is listed on the National Register of Historic Places and is managed by the Historic Glenwood Foundation.

There is little evidence or paper records that indicate when the larger trees that exist on the site today were planted; there are records documenting the planting of some of the shrubbery in recent decades. The most common species on the property is American elm (Fig. 2). The elms share the landscape with a few oaks and maples, trees that represent forest species typical of the Kanawha County (West Virginia) region. We presume most of the trees arose as volunteers. Certainly elm figures prominently because of the proximity of the site to the Elk River, an ideal elm ecosystem.

There has been a history of DED and elm yellows in the Charleston area since these diseases were first reported in the late 1930s. Dutch elm disease is frequently observed in Charleston as American elm continues to repopulate the area naturally and many trees succumb each year. Fortunately, elm yellows is rarely observed.

Figure 2.—Several American elms present on the grounds of the Glenwood Estate in Charleston, WV. Photos by Brian Marr, used with permission.

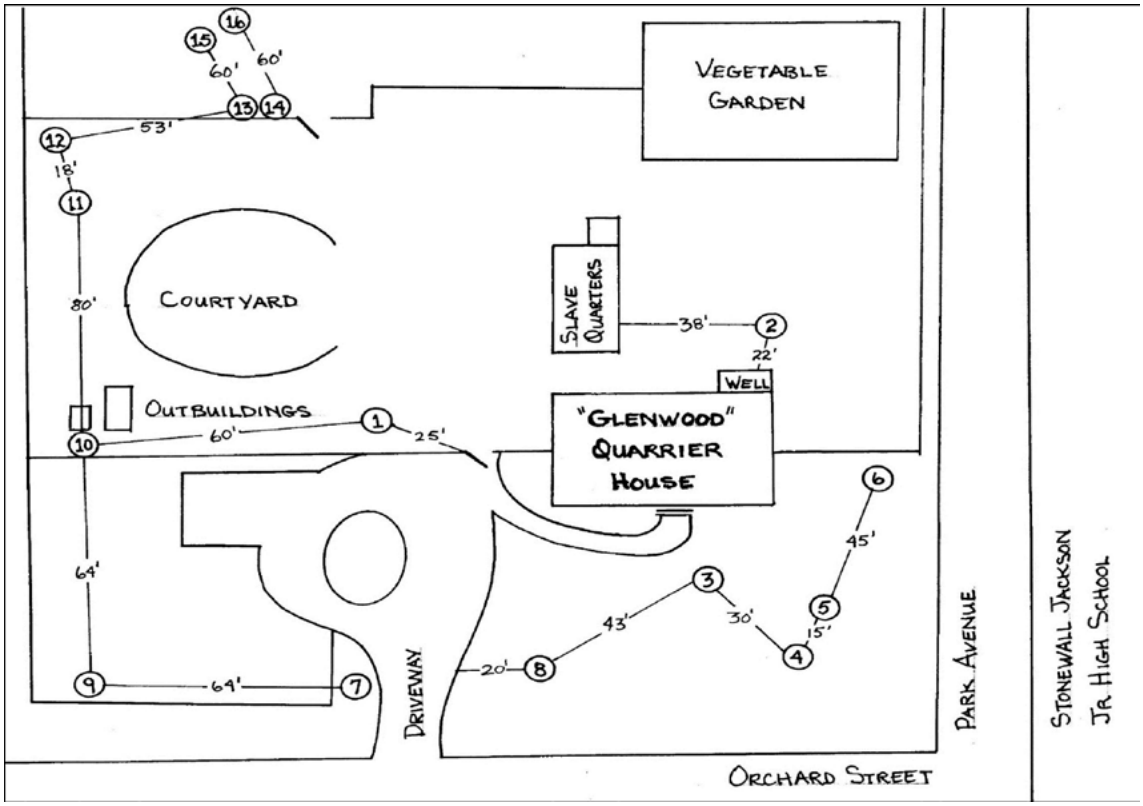

Figure 3.—Schematic of the Glenwood Estate with the American elm trees (1-16) numerically designated.

Materials and Methods

When we began our chemical injection treatment in 1984, there were 16 American elms on the Glenwood property. A few elm stumps were evident, suggesting some trees had already died, presumably from DED. We previously had purchased an elm injection system from the Elm Research Institute (ERI) in Keene, NH, for use at WVU to treat campus elms. We have used this same system and protocol over the 34 years of our involvement at Glenwood. At the time of first treatment in 1984, there was one tree on the property that was displaying the early symptoms of the disease. That year we treated the symptomatic elm and the other healthy elms. In 1984, the trees ranged in diameter from 30.5 cm to 81.3 cm and were distributed throughout the property (Fig. 3). After 32 years, tree diameters ranged from 53.3 cm to 182.9 cm.

The ERI injection protocol involved connecting the injection heads to each other by a Tygon® tubing manifold, drilling injection holes at 10-20 cm intervals on the tree root flares, and then firmly inserting each injection head into a hole (Fig. 4). Arbotect 20-S was chosen for treatment and has been applied in the spring every third year with the exception of a 4-year interval between the 2012 and 2016 treatment. The rate of application was 13.94 ml of chemical per cm of tree diameter. Arbotect was diluted in water so that trees received 32-48 liters of the diluted fungicide depending on their diameter. Uptake of this solution varied for each tree and treatment period, presumably depending on the rate of transpiration. Since we were not resident on the site, Clark Haynes, a forest pathologist with the WVDA, volunteered to periodically check the health of the trees each season.

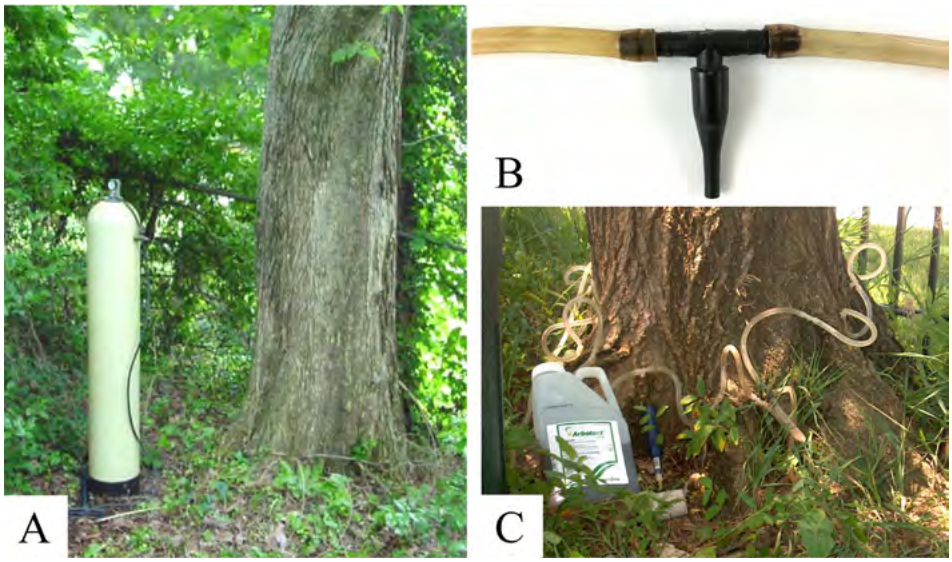

Figure 4.—Elm Research Institute (ERI) injection system: A) fungicide reservoir tank; B) Tygon tubing and injection head; C) injection heads installed in holes along root flare (photo courtesy of VanBooven Tree Care).

Results and Discussion

The chemotherapy for DED was really its infancy when we began the Arbotect injection treatments at Glenwood. Like the technology, our experience with the success or failure of treatment also was very limited. However, over the intervening years it became increasing evident that the treatment had great potential and provided a successful way to manage high value trees. While potential for root-graft transmission of the fungus existed, the treatments eliminated its expression. Of the original 16 elms, we lost four trees over the 32-year period. The original infected tree when we began treatment in 1985 died and was removed soon after. Two trees were removed in 1991 and 2007. We were never advised as to the reason. One additional elm was lost in 2010 when Charleston experienced a devastating windstorm. Overall, the trees have remained healthy and have grown significantly. Their growth is particular noteworthy when observed in an aerial photograph of the Glenwood Estate and the surrounding neighborhood captured by Google Earth (Fig. 5).

The Glenwood Estate remains as a remarkable remnant of the past in a city that grew up around it. Without the populations of majestic American elms that reside there, much of the ambiance of the property would be lost.

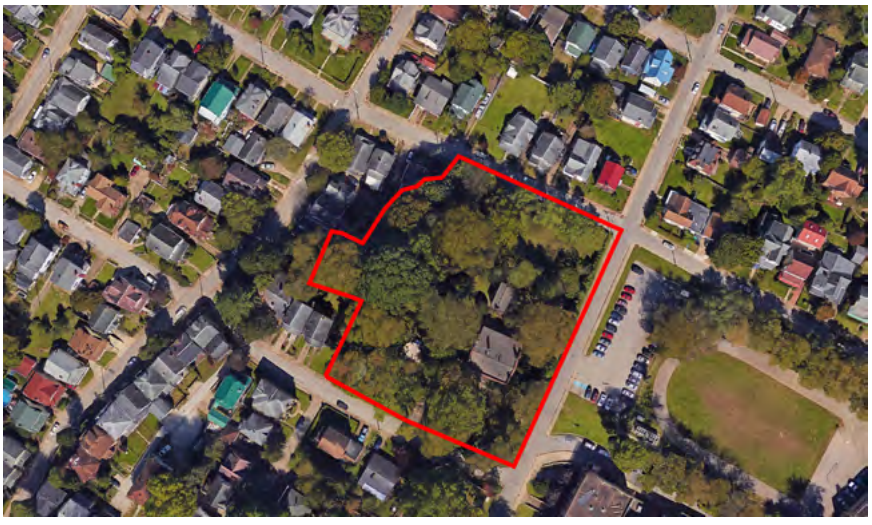

Figure 5.—Aerial view of the Glenwood Estate; property boundary is outlined in red. Google Map.

Literature Cited

Calwell, B. 2014. **Glenwood: a treasure trove of history.** Wonderful West Virginia Magazine. November 2014: 10-12.

Haugen, L.; Stennis, M. 1999. **Fungicide injection to control Dutch elm disease: understanding the options.** Plant Diagnosticians Quarterly. 20(2): 29-38.