

### The Lilly ARBOR Project: An Experiment in Urban Riparian Restoration (Indiana)

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The Lilly ARBOR Project is an experimental riparian restoration project along the White River in downtown Indianapolis. Since 1999, we have reforested 8 acres (20 ha) of the riparian corridor along a 0.6-mile (1-km) reach of a highly engineered urban stream. We designed this experiment to test the relative success of three common reforestation strategies: 1) 3-gallon (13.6-L) containerized stock planted in a grid, 2) bare-root stock planted along random transects, and 3) bare-root stock planted in rows with weed control strategies (3-ft x 3-ft geotextile mats and Canada wild rye [*Elymus canadensis*] planted as a cover crop).

We planted a total of 1,332 trees, with 2 acres (0.8 ha) planted according to each method and 2 acres left unplanted as control plots. All planted plots consisted of the same species composition, 12-ft (0.9-m) spacings, similar numbers of each species, and 204-240 trees per plot. Tree species selected for planting were derived from historical floodplain composition studies (GLO 1799-1834, Lee 1945, Lindsey and others 1961) and included those native species whose geographic range occurs within the riparian forests of the Tipton Till Plain Natural Region of central Indiana. We excluded extremely rare or habitat-restricted species and American elm (*Ulmus americana*) due to Dutch elm disease. We planted hawthorn (*Crataegus* spp.), honey locust (*Gleditsia triacanthos*), swamp white oak (*Quercus bicolor*), chinkapin oak (*Q. muhlenbergii*), red maple (*Acer rubrum*), silver maple (*A. saccharinum*), hackberry (*Celtis occidentalis*), native and non-native buckeye (*Aesculus* spp.; non-native red buckeye [*A. pavia*] was erroneously included in the planting stock), American sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), and black willow (*Salix nigra*).

Site preparation included treating mowed turf grass with glyphosate (Rodeo™). Volunteers and university students participating in service learning programs installed the trees randomly throughout the plots and have been monitoring the plantings.

Our results show containerized plots had significantly higher rates of survival than both types of bare-root methods (Table 1). We found no statistically significant difference in survival rates between the two bare-root strategies. Important differences were apparent between different species in all planting treatments, with honey locust having the highest survival rate (86 percent). Sycamore (9.6 percent survival), black willow (18.4 percent), buckeye (29.1 percent), and cottonwood (33.7

**Table 1. Summary of tree survival compared to cost of each planting method.**

	Containerized stock (n = 420)	Bare-root random (n = 480)	Bare-root, weed-inhibitor (n = 432)
No. surviving/ (% survival)	256 (61)	222 (46)	188 (44)
Material cost	\$5,442.75	\$2,198.35	\$3,459.56
Labor cost	\$3,310.89	\$2,343.76	\$3,160.54
Total cost	\$8,753.64	\$4,542.11	\$6,620.10
Cost per tree planted	\$20.84	\$9.46	\$15.32
Cost per surviving tree	\$34.19	\$20.46	\$35.21

percent) suffered significantly higher mortality than all other species. Unfortunately, reed canarygrass (*Phalaris arundinacea*) has begun to encroach into the site, causing detrimental effects in terms of tree survival and natural recruitment.

The cost of different restoration strategies is often an important factor in determining approach. We assessed the costs associated with initial planting and the cost per surviving tree for each strategy (Table 1). The total cost was calculated by aggregating material and labor cost for each method. Material costs include costs of purchasing and installing the trees. We calculated labor costs using hourly rates plus fringe benefits for undergraduate interns (\$7/hour), staff (\$22.72/hour) and hourly employees (\$10.71/hour). These estimates do not include volunteer hours.

Although the bare-root random method was the least expensive planting method, survival was significantly lower than in the containerized plots. A 60-percent increase in expenditures per surviving tree for containerized stock increased survivability by 15 percent compared to bare-root random trees. Interestingly, our results show that surviving trees planted in the bare-root, weed inhibitor plots cost 58 percent more than surviving bare-root random trees, with no statistically significant difference in survivability.

Our experience suggests that containerized stock produce taller trees more quickly—a factor that may be important when appearance is a restoration goal. By including higher numbers of bare-root stock relative to containerized plants, restoration managers can compensate for the expense of using containerized stock as a strategy for increasing tree survival.

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#### REFERENCES

- General Land Office Survey Records for Indiana, 1799-1834, Volumes 1-8. Archives, Indiana State Library, Indianapolis.
- Lee, M.B. 1945. An ecological study of the floodplain forest along the White River System of Indiana. *Builer University Botanical Studies* 7:1-21.
- Lindsey, A.A., R.O. Petty, D.K. Sterling and W. Van Asdall. 1961. Vegetation and environment along the Wabash and Tippecanoe Rivers. *Ecological Monographs* 2:105-156.