

# THE IMPORTANCE OF DIVERSITY IN SELECTING TREES FOR URBAN AREAS

by A.G. Endress

**Abstract.** The ability of trees to cleanse the air of pollutants, capture and store carbon dioxide as a buffer against the greenhouse effect, and air condition the buildings in which we live and the outdoor spaces we use has become the focal point for several vigorous campaigns to reforest America as a positive step to redress several concerns about the environment. Reforestation is much needed, but its occurrence in a helter-skelter manner should be avoided. A long-term reforestation plan is needed based on (1) the selection of a broad range of plant materials with respect to biologic/genetic diversity and the specific characteristics of the planting sites and (2) the organization, scope, and technical support of tree care delivery systems. Furthermore, there is a critical need to promote arboriculture as a rewarding career so that new students and trainees are attracted.

**Résumé.** La capacité des arbres d'épurer l'air de polluants, de capturer et emmagasiner le dioxyde de carbone comme un tampon contre l'effet de serre, et la condition de l'air dans les édifices dans lesquels nous vivons et les espaces extérieurs que nous utilisons sont devenus le point central de plusieurs campagnes vigoureuses où le reboisement de l'Amérique est vu comme une démarche positive pour rétablir plusieurs inquiétudes au sujet de l'environnement. Le reboisement est grandement requis, mais son utilisation désordonnée devrait être évitée. Un plan de reboisement à long terme basé sur la sélection d'un large éventail de plants est requis, en respectant la diversité biologique/génétique et les caractéristiques spécifiques des sites de plantation et l'organisation, l'étendue et le support technique des systèmes d'entretien des arbres. Bien plus, il y a un besoin critique de promouvoir l'arboriculture comme une carrière glorieuse pour que les nouveaux étudiants et stagiaires soient attirés.

Illinois exemplifies the changing face of America. A recent publication (10) vividly documents how the appearance of Illinois has changed dramatically since the first European settlers arrived. Virtually all of the State's 35,632,000 acres was once covered by vegetation (38% forest and 61% prairie habitats). Today only about 21% of Illinois has vegetated cover (12% forests and 9% pasture plus nonforest with trees). The Illinois landscape has become primarily industrial and agricultural with about 20 million acres in croplands.

Over 11 million people live in Illinois, 9.5 million (83%) of them in urban areas. For many, urban forests are their only exposure to the natural en-

vironment. Among all states, however, Illinois ranks 46th in per capita parklands with only 102,800 acres of urban forest and 139,500 acres of urban areas with trees. The Chicago metropolitan area ranks last among the ten largest national urban centers in this regard. Publicly owned forestland per capita is 0.01 acre or less in the six-county Chicago area. An estimated 6.5 million municipal street trees in Illinois have an estimated value of \$3 billion, and urban forestry is a \$300 million industry in Illinois (Stewart and Reichenbach, personal communication). Municipal tree care accounts for \$25 million, utility line clearance for \$30 million, private tree care for \$100 million, and forest preserves and park districts for \$145 million. The value of privately owned Illinois landscape plants is over \$1.6 billion and the annual maintenance bill is \$34 million (1). National estimates are that one tree is replanted for every four that are removed; in some cases, the ratio approaches 1:20. Some communities, however, plant more trees than are removed.

## Why reforest?

The American public has a keen awareness that trees are an important part of everyday life and essential to our long-term prosperity and well-being. Recent concerns about global warming, climate change, the greenhouse effect, biodiversity, energy usage, increased air pollution, food safety, and the use of chemicals for weed, pest, and disease control have provided potent reminders of the consequences of human activities on the environment. More importantly, the discussion of these concerns has heightened public recognition of the environmental and ecological importance of trees and the significant societal benefits to be gained from a prosperous and expanded forested landscape.

Trees in our urban forests are of particular concern because for millions of people they are a multipurpose resource that contributes in significant ways to a livable environment. The forests of

urban America comprise many billions of trees in streets, parks, residential yards and gardens, and other open spaces. They are every bit a "real" forest that can soak-up pollution, capture and store carbon dioxide, and literally air condition the urban environment. They are a living forest where the selection and arrangement of trees support a wide variety of other plants and wildlife, bring cohesion to the urban design, enhance and reinforce the surrounding architecture, and sustain the human spirit through the recreation and aesthetic experiences they provide.

In 1987, a record breaking 3,000,000 acres of trees were planted in the U.S., one-third of those through the Conservation Reserve Program (CRP). Today, numerous public and private agencies and groups have organized to vigorously promote the increased planting of trees on both urban and rural lands. For example, the Tree City U.S.A. program sponsored by the National Arbor Day Foundation has long promoted tree planting in our communities and every year the number of Tree Cities increases. The American Forestry Association launched its nationwide "Global ReLeaf" campaign to encourage Americans to plant 100 million trees in their communities by 1992. The States of North and South Dakota, the City of Los Angeles, and several other communities have also initiated major tree planting programs and/or imposed restrictions on tree removal during site developments. The Illinois Commerce Commission recently developed and submitted to Governor James R. Thompson the prospectus for a comprehensive program to enhance air quality by planting 11,000,000 trees in 1990.

#### **What are the benefits of reforestation?**

Trees in our communities and urban areas are an invaluable resource. The contributions of trees to both urban and rural America are well recognized and well documented (5-7, 9, 11, 14-18). Trees confer significant economic, environmental, and social benefits and impart values that range from the purely aesthetic and psychological to the overtly economic. Trees enhance the landscape and surrounding architecture, stabilize soils and minimize erosion, reduce noise and glare, create privacy, filter and dilute dust and air pollution, provide wildlife habitat, increase property values, and

impart a sense of well-being. In contemporary Illinois, as across America, however, the rebirth of large-scale reforestation seems to be driven primarily by concerns about the environment and the possibility of significant change in the climate.

Many tree planting campaigns are being promoted because trees capture and store carbon dioxide, thus reducing the amount contained in the atmosphere, helping to offset emissions from the burning of fossil fuel, and slowing climate change from the greenhouse effect. A mature tree removes carbon dioxide from the atmosphere through photosynthesis at the approximate rate of 48 pounds per year, about 10 tons per acre of trees. The amount of carbon stored annually by an acre of trees is approximately equivalent to the amount released by burning 1,000 gallons of gasoline. A tree that provides shade and wind protection to buildings can indirectly cause via energy conservation reductions in carbon dioxide emissions equivalent to 15 times the amount of carbon dioxide the tree alone can absorb. The "Global ReLeaf" program, for example, could save utility ratepayers an estimated \$3-4 billion annually while offsetting 18 million tons of carbon emissions.

#### **What are the potential risks of large-scale reforestation?**

The growing impetus for planting trees to redress a variety of environmental concerns is likely to produce massive plantings of trees. But tree-planting by itself is not a cure-all; neither will it succeed in the longterm if it occurs helter-skelter as a result of the fervor of groups acting independently and without concern for the very real risks that could develop.

As laudable and helpful as reforestation objectives are, there seems to be little concern about the dangers that will follow these extensive efforts unless special care is taken now to ensure that (1) sufficient capabilities, resources, and expertise are available to care for this expanded forested landscape and (2) a large variety of tree species and cultivars are planted at locations where they can prosper (12). If left unchecked, reforestation efforts are likely to produce massive plantings of only a few fast growing species. Furthermore, these trees will be evenly aged unless precau-

tions are taken to develop a long-term reforestation plan. Aside from an aesthetic bleakness, the resultant dangers are these:

1. Species uniformity that leaves the newly forested landscape extremely vulnerable to new environmental challenges and diseases that frequently achieve epidemic proportions in monocultures.
2. Escalating costs to care for and regrettably replace a large number of trees that were planted at locations for which they were not adapted.
3. Insufficient information about the performance requirements of trees in our community and urban forests; too few arborists, urban foresters, and other trained tree-care professionals; and inadequate lines of communication for exchange of research and management expertise and information.
4. Inadequate strategies for tree maintenance and disease and insect control on this expanded acreage that do not place the environment at risk.
5. Failure to nurture, preserve, and protect the genetic and biologic diversity of tree species for future use.

### What is needed?

As millions of trees are planted across Illinois in response to reforestation programs, the State will experience a dramatic facelift, perhaps even recapturing its youthful forested visage. To achieve the full potential offered by a vigorous and healthy treescape, however, many carefully planned actions must occur. In order to anticipate possible consequences, the reforestation process must be carefully "thought through" and the plans, skills, and information of each individual, group, and agency carefully integrated. In my opinion, the greatest attention should be given to three areas: (1) the selection of plant materials with respect to both biologic/genetic diversity and the specific characteristics of the planting sites; (2) the organization, scope, and technical support of tree care delivery systems; and (3) the promotion of arboriculture as a rewarding professional career.

**Selecting cultivars.** The selection of species and cultivars should govern the extensive

reforestation efforts that are underway or about to begin so that the hazards of species uniformity in urban forests can be avoided. A greater variety of plant materials must be sought, and these materials should be planted where they will not only survive but thrive. Information about the thousands of cultivars that are available must be systematically developed and readily available. Species and cultivar-specific information regarding best use, disease problems, soils specifications, weather (climate) requirements, natural distribution, sensitivity to air pollutants (dusts, salts, etc.), longevity, care and maintenance needs, and other important performance indicators must be identified. There is a real need to know what to plant where and what not to plant there. Scientists at The Morton Arboretum have been working on this formidable task with some support provided by the Illinois Governor's Office. In addition, the U.S. Forest Service and the National Association of State Foresters are jointly participating in a major effort, the Directory of Landscape Cultivars Project. With numerous cooperators from government, academia, and industry, this project is headquartered in the Municipal Tree Restoration Program at The Pennsylvania State University, and has as its main purpose the development of street tree factsheets containing concise, practical information about street tree cultivars that are readily available. The first publication from the project is very well done and should be useful to many arboriculturists (4).

The Illinois Natural History Survey would like to develop a new Illinois-specific vegetation hardiness map, based on the U.S.D.A. hardiness zones map, by integrating the extensive and detailed record of the State's climate and weather patterns with species and cultivar-specific information. This map would subdivide Illinois into several smaller climate zones and provide a guideline for selecting plant species and cultivars suitable for vigorous growth in each zone. This map would be based on acclimation, a concept that includes a hardening process through exposure to cool temperatures, shortening photoperiod, and eventual cold temperatures. Deacclimation, the breaking of dormancy, will also be considered. The maps and accompanying lists of recommended plant species would guide public

and private forestation efforts, promote growth and development of the green industries, and provide an information base for decisions about tree placement.

**Delivering tree care.** The reality of urban tree care practices, unfortunately, falls short of what is possible. Those who strive to develop and maintain a robust tree-filled landscape are too few in number and too often must make do with inadequate resources (2). Too often they must operate with some degree of crisis management, dealing with extremely unhealthy trees because inadequate attention was given to site and cultivar selection and to post-planting care and maintenance. The planting of tens of millions of new trees in Illinois in the next few years will greatly intensify the demands on the already limited number of tree care professionals. Solutions are at hand, but the American public and the arboriculture professional have not yet benefited from them because a carefully planned and integrated approach to the selection and management of trees has not been developed and implemented.

Tree care professionals need to be more cognizant of the public's commitment to a cleaner environment. Practitioners must be able to protect the trees of urban America while minimizing the environmental impacts of their practices. The adaptation and implementation of integrated pest management (IPM) strategies for the care of trees have been advocated before and are currently being evaluated through the joint support of the National Arborist Association Inc. and the International Society of Arboriculture. The IPM approach is a significant departure from the usual tactics of many practitioners, but it is well worth considering. IPM's attractiveness begins with its holistic perspective centered on environmental stability and integrity. It is a management-oriented approach that minimizes crises, emergency interventions, and reliance on chemical controls by integrating multiple strategies to avoid and control pests. Instead, preventative, anticipatory care and maintenance are substituted.

Arboricultural practitioners, researchers, and managers must have ready access to technical information and information management resources if they are to succeed. With a significantly larger

tree population to care for, the industry will be even more dependent on the availability of information, and still more so as innovative IPM practices are embraced. Appropriately timed and environmentally acceptable intervention in disease and pest problems places a considerable premium on accurate information. Provision for an integrated database is the essential foundation of the NAA/ISA initiative on IPM for arboriculture. Certainly additional scientific research is needed and funds to support tree research must be substantially increased. Computerized databases can stimulate research efforts by identifying knowledge gaps, however, if existing scientific information and the results that will come from future research are not readily accessible in easily understood forms, they might as well not exist at all.

Others are championing the importance of developing a strong communication infrastructure for tree care delivery and are trying to facilitate its implementation at all levels (8, 10, 13). In "Forestry, A Community Tradition" (13), the National Association of State Foresters and the U.S.D.A. Forest Service noted that "State and local professionals, volunteers, and community groups need the latest information on the care of urban and community forests [in an] improved information transfer system [that] could incorporate and strengthen the existing databases...." This thought was echoed by the Illinois Commission on Forestry Development. In its report (8) "Forestry in Illinois: Opportunities for Action", the Commission's recommendations make clear that the common requirement for the exchange of information is a computerized database. The desire for a publicly visible, easily accessed, centralized depository of urban and community forestry information that will facilitate the exchange of that information has spurred the development of several local and regional database networks and the merger of Arbor Base and NuTree Net to form a national network known as TreeNet. All of us should use these systems and actively contribute to making them more fully useful. These computer networks and databases ought to focus more on consumer and practitioner needs than on compiling a bibliography of scientific journal articles; their emphasis should be on practical application and

technical information.

**Promoting careers in arboriculture.** In the near future, the arboriculture industry will face a severe shortage of qualified employees (2-3). Every effort must be made to retain current employees, and in-service training and educational experiences should be expanded. The International Society of Arboriculture and the National Arborist Association have collaborated to produce striking color brochures describing opportunities in the industry. It is particularly crucial to introduce students to the challenging and exciting career opportunities offered by the tree care industry and to present these opportunities in attractive and inspiring contexts. Relatively few colleges, universities, and other training institutes offer courses in arboriculture. Arboriculture has recently experienced the same declining enrollments that have plagued other agriculture-related programs, despite the expanding opportunities in the field. Many students (and high school counselors!) are currently unaware of career openings in arboriculture (3).

The expanded forested acreage, particularly in urban areas, will create numerous employment opportunities and those with the best skills will be highly sought after. The arbor employee will increasingly need broader knowledge and more sophisticated skills as more trees are planted, as the species diversity of those plantings increases, and as ecologically based techniques supplant those of pruning and desperation spraying. These circumstances should challenge the industry to make a strong outreach to the potential future workforce, both at the high school and college levels, to publicize the ballooning opportunities and to promote awareness of the profession. The arborists who will respond to increasing urban reforestation demands will require both practical experience and keen understanding of ecological implications. To attract new recruits, therefore, arbor professionals must champion the dignity, diversity, and scientific basis buttressing arboriculture.

**Acknowledgments.** Special thanks are extended to L. Iverson, D. Neely, M. Reichenbach, and M. Smith whose discus-

sion and comments on early versions of this manuscript were very helpful.

### Literature Cited

1. Dickinson, D.B. 1987. *Challenges for the future*. Illinois Research 29:2.
2. Felix, R. 1987. *Arboriculture: A career in search of employees*. Amer. Nurseryman Feb. 1, p. 59-66.
3. Felix, R. 1988. *The tricky business of hiring: Recruiting practices and pre-hire investigations*. Arbor Age 8:13.
4. Gerhold, H.D., Wandell, W.N., Lacasse, N.L., and R.D. Schein, eds. 1989. *Street Tree Factsheets*. Municipal Tree Restoration Program, School of Forest Resources, The Pennsylvania State Univ., University Park. 254p.
5. Heisler, G.M. 1977. *Trees modify metropolitan climate and noise*. J. Arboric. 3:201-207.
6. Heisler, G.M. 1986. *Energy savings with trees*. J. Arboric. 12:113-125.
7. Holmes, F.W. 1977. *Shade trees—the friends of the poor and of the city-dweller*. J. Arboric. 3:176-177.
8. Illinois Commission on Forestry Development. 1986. *Forestry in Illinois: Opportunities for Action*. 33p.
9. Illinois Council on Forestry Development. 1988. *Urban Forestry Practices in Illinois: Analysis of a Survey*. 42p.
10. Iverson, L.R., Oliver, R.L., Tucker, R.L., Risser, P.G., Burnett, C.D. and R.G. Rayburn. 1989. *Forest Resources of Illinois: An Atlas and Analysis of Spatial and Temporal Trends*. Illinois Natural History Survey Special Publication 11. 181p.
11. Kielbaso, J.J., Beauchamp, B.S., Larison, K.F., and C.J. Randall. 1988. *Trends in Urban Forest Management. Baseline Data Report. Vol. 20, No. 1*. International City Management Association. 17p.
12. Ledig, F.T. 1988. *The conservation of diversity in forest trees*. BioScience 38:471-479.
13. National Association of State Foresters and U.S.D.A. Forest Service. 1988. *Forestry: A Community Tradition*. 22p.
14. Neely, D., ed. 1988. *Valuation of landscape trees, shrubs, and other plants. A guide to the methods and procedures for appraising amenity plants*. 7th ed. International Society of Arboriculture, Urbana, IL. 50p.
15. Nelson, W.R., Jr. 1975. *Trees in the landscape: a look beyond the obvious*. J. Arboric. 1:121-128.
16. Roberts, B.R. 1980. *Trees as biological filters*. J. Arboric. 6:20-23.
17. Rudie, R.J., Jr. and R.S. Dewers. 1984. *Effects of tree shade on home cooling requirements*. J. Arboric. 10:320-322.
18. Weyerhaeuser Company. 1986. *The value of landscaping*. Weyerhaeuser Nursery Products Division, Division Campus Center Building 6-B, Tacoma, Washington. 27p.

Center for Biodiversity  
Illinois Natural History Survey  
607 E. Peabody Drive  
Champaign, IL 61820