TREE INFORMATION PLANNING SYSTEM (TIPS)

by Jeffrey Murgas

Abstract. The Tree Information Planning System (TIPS) is a computer system that was developed to assist a landscape designer, urban forester or parks planner to find the optimum tree for a site. By relating site characteristics entered by the user to the site requirements of each tree on file, TIPS provides a list of suitable trees. TIPS also provides a brief description of the tree and a printout of the site characteristics required by the tree.

Frequently there is little or no consideration of a tree's requirements for good growth when designing landscapes. Through improper planting, trees suffer from reduced vigor and are susceptible to disease and insects (Sheppard 1976). Probably ninety percent of the disease and insect problems in urban trees are man caused either through improper selection of trees or from damages incurred during construction (McGraw 1980). A short drive around any city will provide many examples of trees that either were planted on the wrong site or suffer damage from construction. In order to reduce tree replacement, maintenance, or removal costs, planners need to select trees that are able to grow where they are planted.

There are no information systems available to parks planners or urban foresters which can be used to select the best tree for a given site or in developing a site for protection of valuable existing trees. In the planning phase the planner either must search existing literature for information about various species or randomly choose a tree of which he has some knowledge. Many times designers have limited knowledge of trees and thus often choose the wrong tree. The other problem facing urban foresters and parks planners is damage to existing trees due to lack of knowledge of tree requirements. Many trees suffer from growth reduction due to poor placement of trails, roads, campsites, and other facilities. The casualty loss of trees ten inches or greater in diameter may run into thousands of dollars. A tree information system is needed to minimize losses, especially of large, valuable, mature trees.

The Tree Information Planning System (TIPS) is a computer program that will enable a planner to input site conditions and receive a list of trees best suited for the site. Each tree also has available a description so that a planner can choose a tree that meets the aesthetic needs of the site. The planner can also enter the identification number and receive the site requirements necessary for optimum growth.

Justification

The TIPS program is intended to reduce costs to parks departments and urban forestry departments through tree management. The system is designed to: 1) reduce planning time and tedium involved in choosing suitable trees, 2) reduce tree replacement costs resulting from poor tree selection, 3) eliminate unnecessary maintenance costs that result from poor tree selection, and 4) minimize repairs to damaged trees by reducing construction damages.

Because the average cost of purchasing and planting trees begins at ±$140 and ranges upward, it is necessary to plant the trees best suited to a site. In cases involving large trees it is technologically and financially difficult to replace them, therefore, it is important that damage to and losses of existing trees be kept to a minimum.

Another advantage of TIPS is that landscape designers can select trees for a large variety of areas without having to do a literature search for native or suitable exotics. The brief description included in TIPS allows the planner to choose a tree that fits the site conditions and the aesthetic requirements of the project.

Data

The TIPS program is divided into two files, *Ident. Data* and *Tree. Data.* The Ident. file includes site requirements relative to each tree on file. By com-

paring specific site characteristics entered by the planner with the general requirements of each tree in the Ident. file, TIPS generates a listing of tree species most suitable for the site in question. The Tree. Data file contains brief descriptions and site requirements. This file can be accessed either after obtaining the TIPS list of suitable trees or when a planner desires to obtain site requirements of a specific tree.

Data for TIPS was collected from an extensive review of existing literature. The available information for some trees is limited. For these trees a null value was entered for the missing site characteristic. This value causes the program to skip that characteristic when evaluating appropriateness of a tree.

Identification Data File

There are eight constraining site characteristics included in TIPS:

A. compaction
B. soil type
C. pH
D. soil moisture
E. maximum temperature
F. minimum temperature
G. shade tolerance
H. tree's reaction to pollutants.

Compaction. There are three classifications representing a tree's tolerance to soil compaction in its root zone:

1. little or no compaction
2. moderate compaction
3. heavy compaction

Of course, trees capable of growth on compacted sites can also grow on other sites, but the opposite is not always true. Since fewer suitable trees are available as site factors become more limiting, the list generated by TIPS becomes shorter.

Soil Type. There are five soil type classifications:

1. sandy loam
2. loam
3. sandy
4. clay
5. variety

The reason that a classification "variety" is included is that many trees maintain good vigor on a variety of soils, where as others are soil type specific. Most trees that grow well in clay also grow well in the first three soil types. TIPS sorts for Soil Type in the same manner as for compaction.

pH. The user need only to enter the site pH. TIPS selects trees whose pH range includes the site pH.

Soil moisture. Soil moisture has two divisions: moist and dry. It is difficult to find more specific moisture levels that can be programmed by the average user. Infiltration and percolation rates are not included in soil moisture since these factors are somewhat complicated and interrelate with Compaction and Soil Types.

Temperature. Maximum average summer and minimum average temperatures are included in TIPS since these temperatures are critical to tree survival. For the minimum temperature, plant hardiness zones are used. The planner enters the plant zone of the area. The planner needs to remember that microclimate conditions may change the plant zone of a site.

Maximum average summer temperature ranges are:

1. 60-69
2. 70-74
3. 75-79
4. 80-84
5. 85-89
6. 90-94

These temperature characteristics are included in TIPS to assist the selection by non-local planners.

Shade tolerance is more related to young, rather than mature trees. There are three divisions of Shade Tolerance:

1. sunny
2. shady
3. partial shade

These levels are adequate for the system and are more easily judged than actual light intensity levels required by the tree.

Tree's reaction to pollutants. The last decade has seen an increasing awareness and concern of the effects of pollutants on trees, especially in urban areas. TIPS includes nine pollution tolerance classifications:

1. sensitive to sulfur dioxide
2. sensitive to ozone

3. sensitive to ozone, sulfur dioxide
4. sensitive to sulfur dioxide, ozone, hydrogen fluoride
5. sensitive to nitrous oxides
6. sensitive to PAN
7. tolerant to sulfur dioxide, ozone
8. tolerant to sulfur dioxide
9. tolerant to ozone

The eight site characteristics described above are restricted to the characteristics most constraining to optimum growth (Pirone 1978). The divisions are kept relatively general so that most planners who have had limited training in hydrology, soil science, or related fields are able to use TIPS. TIPS can be made much more complex, but would become too cumbersome.

Tree Description File

The second file consists of the following tree descriptions:

1. deciduous or evergreen
2. autumn color
3. color, time, and visibility of flower
4. fruit characteristics
5. growth rate
6. size at maturity
7. maximum age
8. foliage texture
9. branching pattern
10. brittleness of wood
11. major insect and disease problems
12. special characteristics such as thorns or bark patterns
13. favorable site characteristics

This file can be accessed and used after a list of trees fitting a site is obtained or by simply entering the tree identification number. This approach should be useful to a planner who wants to find the site conditions required by a species. The tree identification numbers can be acquired by reviewing the file *Sci. Data* or *Common. Data*. Sci. Data lists trees alphabetically by scientific name whereas Common. Data lists trees alphabetically by common name.

System Description

The program for TIPS is written in Fortran, a widely used computer language. A planner using TIPS follows the following steps:

Step 1. Activate the program by entering EXEC TIPS

Step 2. The computer asks:
"Do you want to see a list of Site Characteristics (such as Shade or Temperature Requirements)." If the user enters YES, a list of site characteristics is displayed. If NO is entered, the program advances to step 7.

Step 3. The computer asks the user to enter the letter of the Site Characteristics which he finds limited to good tree growth.

Step 4. The levels of the entered site characteristic are displayed and the user enters the appropriate level.

Step 5. The computer asks:
"Do you want to:
A. see the list of characteristics?
B. change a characteristic?
C. list the trees meeting your current specifications?
Choice "A" returns the user to Step 2, choice "B" returns to Step 4, and choice "C" advances the user to Step 6.

Step 6. A list of trees is displayed and stored in a temporary file — MATCH.DATA for later reference.

Step 7. The computer asks the user if he wants to select a tree by its Identification number. If the user enters YES, the computer goes to Step 8. If the response is NO, the program moves to Step 11.

Step 8. The computer asks the user if he wants instructions on how to enter the I.D. number. If the user response is NO, the program advances to Step 10.

Step 9. The computer provides instructions as to how to enter an I.D. number.

Step 10. The user enters the I.D. number of a tree that he is interested in.

Step 11. The computer asks the user:
"Do you want to:
A. see a tree description?
B. list the trees meeting the current specifications?
C. specify characteristics?
D. stop?"

Selection "A" returns the user to Step 10, "B" displays the list of trees stored in MATCH.DATA, "C" returns the user to Step 5, and "D" ends the session.

System Constraints

TIPS is a computer assisted system for aiding a parks planner or urban forester quickly, efficiently, and more objectively make decisions about urban or park tree selection. Urban situations pose additional problems for the planner. Restricted ground space, restricted crown space, underground utilities and residual building materials are just a few of the problems. A landscape designer must decide the potential for a tree species under existing and future space restrictions. If the trees listed by TIPS are not suited for the given space restrictions, the planner needs to consider alternate trees or other planting material.

In the event that TIPS provides no trees that are suitable, then the planner should choose from the following alternatives: 1) alter the site so that suitable trees can be found, 2) use alternative plant material such as shrubs or groundcovers, or 3) use trees that are not optimally suited to the site and risk a potential loss of vigor.

Trees can survive on sites for which they are not optimally suited, but a sacrifice in tree quality and reduced vigor will result (Bilderback 1980). In addition, trees in poor health are generally more vulnerable to certain insect and disease problems than healthy trees.

The TIPS system makes no attempt to provide maintenance schedules for pruning and fertilizing. Obviously these schedules depend on the specific trees involved as well as the site. The commercial availability of tree species may pose problems in some areas. An attempt has been made to include native species in TIPS. However, many of these trees are not commonly grown by local nurseries. Planners need to work closely with local nurseries when making the final selection of trees.

Other constraints not addressed in the TIPS program are problems with size of trees planted. Large trees tend to lose more vital feeder roots than small trees when dug unless they have been root pruned for at least two years prior to digging (Kozlowski 1975). Due to lesser root damage, smaller trees tend to become established quicker than large trees. The best size of trees for planting ranges from ¾-1½ inches in caliper at the base of the stem (Pirone 1978). Besides becoming established less quickly, larger trees are more expensive.

By conferring with extension forestry specialists, landscape architects, and nursery operators, the above constraints have been recognized. Through further developments of TIPS, many of these constraints may be eliminated. Other constraints may be minimized by well-trained and experienced urban foresters and landscape planners.

Future Development

The approach to tree selection in park and urban situations through TIPS as it is presently developed is a prototype system. Program and data base expansion to include all trees native to the Eastern United States as well as suitable exotics is possible. Expanding TIPS data base beyond the Eastern United States may result in additional tree availability problems and make the system cumbersome. In this case it would be advisable to develop a TIPS program for trees of the Western United States.

From discussions with extension forestry specialists, landscape architects and nursery operators, it is felt that other systems that can be developed in conjunction with TIPS are: 1) a computer assisted system to select horticultural varieties, 2) a system to assist in the selection of shrubs, and 3) a reference system listing trees available at various nurseries. The first two systems are self explanatory. The third system would be a library developed system in cooperation with nurserymen and planners. Not only would this system provide an urban forester with a list of nurseries from which needed trees are available, but it would also enhance a much needed communication between planners and nurserymen.

Summary

TIPS is a first generation computerized system that assists a parks planner or urban forester in choosing trees most suited to a given site. Presently the system includes trees native to North Carolina, but through future expansions TIPS may include all trees native to the Eastern United States as well as suitable exotics.

With TIPS, a planner is able to find trees that fit existing sits and he is able to quickly find the site requirements for a given tree. By using TIPS, losses due to poor tree selection and construction damage can be reduced.

Literature Cited

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ABSTRACT

KLETT, J.E. and IRIS THORESON. 1981. **Hardy, low maintenance shrubs suit Great Plains landscapes.** Weeds, Trees & Turf 20(1): 16-18.

The climatic conditions of the Great Plains present a real challenge for growing woody ornamentals. Evaluation research which yields a greater variety of plant material adaptable to rigorous climates has been conducted for many years at various state universities and arboreta in the Great Plains. Several shrubs from our research trials have emerged as oustanding small shrubs (generally maturing 4 feet or less) because of their growth habit and other good ornamental characteristics. Plants falling into this category include: *Abeliophyllum distichum* (Korean abelialeaf), *Amorpha brachycarpa* (short-podded leadplant), *Berberis koreana* (Koren barberry), *Caragana pygmaea* (Pygmy peashrub), *Diervilla lonicera* (dwarf bush honeysuckle), and three cultivars of *Potentilla fruticosa.* Shrubs falling into the more medium height category (4-8 feet tall) from our trials, which are more maintenance-free and will withstand rigorous climates include: *Caragana frutex* 'Globosa' (globe caragana), *Cornus sericea* 'Isanti,'' *Lonicera tatarica* x 'valencia' (Valencia honeysuckle), *Philadelphus* x *lemoinei* (Lemoine mockorange), *Sorbaria sorbifolia* (Ural false spiraea), *Viburnum opolos* 'Compactum' (compact European cranberry bush), and *Syringa meyeri* (Meyer lilac).