DEVELOPMENT
OF AN APPLIED MICROCOMPUTER
PLANT RECORD TRACKING/MAPPING SYSTEM

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OVERVIEW

The American Association of Botanical Gardens and Arboreta's (A.A.B.G.A.) computer-use survey (Murbach, 1984) indicated that within five years, an estimated 79 percent of the public horticultural institutions in North America will be in some stage of computerizing their plant records and that microcomputers will be the choice of machines. The survey results also point out the great confusion among institutions on how to computerize plant records.

In many situations, garden staff chose simple-to-use database programs to get started, and then realized that the reason they were simple was their lack of depth and lack of capabilities. On the other hand, those that started with complex programs were boggled by the incomprehensible manuals. In 1985 a prototype plant records system was developed for presentation at the Longwood Graduate Seminars. This IBM microcomputer-based Plant Record Tracking System was developed to record and track plant information. The author hoped to provide a user-friendly, menu-driven method of entering and retrieving plant record information, yet keep the plant records in a complex database that could eventually serve all the needs of the institution. Information such as accession number, family, genus, species, subspecies or variety, location, nativity, source, and plant notes are tracked based on unique accession numbers. Interest was shown in this dBase II based application, but development was delayed pending a practical situation with which to work.

In 1986 Staten Island Botanical Garden staff obtained an Institute of Museums Services grant to promote work on the menu-driven dBase II application, add mapping capabilities, and then apply it to their plant record-keeping.

The prototype menu-driven system was updated to dBase III Plus, more capabilities were added, tie-ins to AutoCad (computerized drafting program) were made and the finished product was demonstrated at the Northeastern Regional Meeting of the A.A.B.G.A. at Smith College in August, 1987 and then presented to Staten Island Botanical Garden.

The Plant Record Tracking/Mapping System is available from the author at no charge to not-for-profit institutions for use as is, or as a modifiable base to adapt to specific institutional requirements.

DEVELOPMENT AND DESCRIPTION OF SOFTWARE

Database structure (figure 1) was modeled upon the list of minimal data elements proposed in 1985 by the North American Data Bank Committee of the A.A.B.G.A. Discussion has often centered upon how much information should be stored in each plant record. The author prefers a minimal amount because of the small number of gardens who have actually completed entering a large quantity of plant information into their plant record systems. It is better to have a small set of complete data entered on each plant rather than a lot of data on many plants, but not all in your collection. A complete set of data allows one to answer the most commonly asked questions. Do we have this plant? Where is it located? Can we have a listing by location of all plants? Can we have a listing of all plants by scientific name ordered by genus? By completing a set of information on your plants, the system is usable and can start saving you time. Once that is functioning, more fields and more data can be added to each record.

Field Names	Field Type	Number of Characters	Example
ACCNUM	CHARACTER - 6		87001
FAMILY	CHARACTER - 25		Aceraceae
GENUS	CHARACTER - 20		Acer
X	CHARACTER - 1		X
SPECIES	CHARACTER - 20		palmatum
VAR	CHARACTER - 20		var.
LOCATION	CHARACTER - 10		L2
NATIVITY	CHARACTER - 20		Japan
SOURCE	CHARACTER - 30		Longwood
UPDATE	DATE - 8		12/12/87
NOTES	CHARACTER - 40		Great plant!
NOTES2	CHARACTER - 40		Good habit.

FIGURE 1. List of Data Fields in Plant Record File

Once structure was chosen, the search for a database vehicle started. dBase III Plus by Ashton-Tate was chosen for several reasons. Foremost was its widespread acceptance in all computer markets. Over one million copies have been sold. An estimated two to three million copies are being used. The nearest rivals have sold less than 200,000 copies. In addition, at the time the computer use survey was conducted in 1984, more public horticultural institutions were using dBase (23%) than any other program. Widespread acceptance and sales is important for survival of a program. Continued development and updating of a program occur only if a program is selling well. Plant records are a long-term investment and it is important to find a program that will continue to evolve as computer technology advances. Important also as criteria for selection, are the strength, flexibility and depth of the database program. In terms of plant records, the program must be able to store as many fields of information as necessary, of several hundred characters of length; must be able to sort and select on multiple "and", "or", "not" criteria; must be flexible enough to add, delete and modify fields and field lengths; the program should include a programming language; and the program must be quick. In addition to plant records, the database program should be able to handle all the institutional database needs such as accounting, membership, mailing, etc. dBase meets these requirements and is the system chosen to be the programming base for the menu-driven Plant Records Tracking System.

Similar criteria were used for selection of AutoCad by Autodesk, Inc. as the mapping/drafting program. AutoCad is by far the leading program in sales of all mapping programs, assuring a good base for knowledge about use and for longevity of program life and updating. Important features for plant record mapping include the abilities; drawing, layering, zooming, block entities, programmable command language, and interfacing with dBase III Plus. There is much more depth to AutoCad than is needed for this basic plant record tracking/mapping system. Once plant information is up and running on the basic system, tremendous capabilities are available.

After the dBase and AutoCad programs were selected, programming commenced. The idea was to provide two compatible modules. The first module is the menu-driven plant record tracking system designed to work without the mapping module. The second is the mapping module created to add onto the plant record tracking system. Basic configuration of the tracking module is tree-structured from an initial menu-screen called "Main Menu". Five options are presented (figure 2) which when chosen lead to the four branches of the program and the fifth option to end the program. The first option leads to a Display Menu (figure 3) with

```
******************************************************************
*                                                                *
*               PLANT RECORD TRACKING/MAPPING SYSTEM             *
*                                                                *
*   1. SELECT AND DISPLAY RECORDS                                *
*                                                                *
*   2. SELECT AND PRINT RECORDS                                  *
*                                                                *
*   3. SELECT AND PLOT RECORDS                                   *
*                                                                *
*   4. EDITING AND FILE MAINTENANCE                              *
*                                                                *
*   5. END PLANT RECORDS PROGRAM                                 *
*                                                                *
*                                                                *
*                                                                *
*                                                                *
******************************************************************
          SELECT ONE....
```

FIGURE 2. Main Menu Screen

```
******************************************************************
*                                                                *
*                   DISPLAY MENU                                 *
*                                                                *
*   A. Display Plant Records By A Specific Range of Accession #"s *
*   B. Display ALL Plant Records in Accession Number Order       *
*   C. Display Plant Records By Specific Genera                  *
*   D. Display ALL Plant Records Grouped By Genera               *
*   E. Display Plant Record(s) By a Specific Location            *
*   F. Display ALL Plant Records Grouped by Location             *
*   G. Display Plant Record(s) By Specific Source                *
*   H. Display ALL Plant Records Grouped By Source               *
*   I. Display Plant Record(s) By Specific Update Date           *
*   J. Return To Main Menu                                       *
*                                                                *
*                                                                *
*                                                                *
*                                                                *
******************************************************************
          SELECT ONE....
```

FIGURE 3. Display Menu Screen

```
******************************************************************
*                                                                *
*                   PRINT MENU                                   *
*                                                                *
*   A. Print Plant Records By A Specific Range of Accession #"s  *
*   B. Print ALL Plant Records in Accession Number Order         *
*   C. Print Plant Records By Specific Genera                    *
*   D. Print ALL Plant Records Grouped By Genera                 *
*   E. Print Plant Record(s) By a Specific Location              *
*   F. Print ALL Plant Records Grouped by Location               *
*   G. Print Plant Record(s) By Specific Source                  *
*   H. Print ALL Plant Records Grouped By Source                 *
*   I. Print Plant Record Card By Specific Accession Number      *
*   J. Print ALL Plant Record Cards                              *
*   K. Print Plant Record(s) By Specific Update Date             *
*   L. Return To Main Menu                                       *
*                                                                *
*                                                                *
******************************************************************
          SELECT ONE....
```

FIGURE 4. Print Menu Screen

options for selecting certain plant records to be displayed on the screen. The second Main Menu selection leads to a Print Menu (figure 4) with options for selecting certain plant records to be printed in report form. The third Main Menu selection leads to a Plot Menu (figure 5) with options for plotting the map. This option only works if the mapping module is installed with associated computer hardware. The fourth Main Menu option leads to an Edit Menu (figure 6) with options for editing and file maintenance. Found here are the means to easily add and delete records, backup your files and if the mapping module is installed, update the graphics (add and delete plant locations directly on garden map).

The Plant Record Tracking/Mapping System has a series of dBase command files (procedural files), dBase index files and AutoCad command files (Lisp files) that interact to create the functioning program. An Operations Manual detailing these interactions can be provided upon request. At completion of the programming, extensive error checking was done to test for programming bugs and reliability.

```
DATE: 02/28/88                            PRG: MAIN            PLOT MENU
=======================================================================

**********************************************************************
*                                                                    *
*                   PLOT MENU                                        *
*                                                                    *
*  A. Plot Specific Named View (Quadrant)                            *
*                                                                    *
*  B. Plot Complete Garden                                           *
*                                                                    *
*  C. Return to Main Menu                                            *
*                                                                    *
*                                                                    *
*                                                                    *
*                                                                    *
*                                                                    *
*                                                                    *
*                                                                    *
*                                                                    *
**********************************************************************
       SELECT ONE....
```

FIGURE 5. Plot Menu Screen

```
DATE: 02/28/88                            PRG: MAIN            EDIT
=======================================================================

**********************************************************************
*                                                                    *
*                  EDIT SUBMENU                                      *
*                                                                    *
*  A. Add Plant Records                                              *
*                                                                    *
*  B. Find Specific Accession Number To Edit                         *
*                                                                    *
*  C. Find Specific Plant Record By Latin Name To Edit               *
*                                                                    *
*  D. Delete Specific Plant Record By Accession Number               *
*                                                                    *
*  E. Back Up Plant Records File (Plantrec.dbf)                      *
*                                                                    *
*  F. Update Graphics                                                *
*                                                                    *
*  G. Return to Main Menu                                            *
*                                                                    *
**********************************************************************
       SELECT ONE....
```

FIGURE 6. Edit Menu Screen

HARDWARE AND SOFTWARE REQUIREMENTS

To operate Module 1 - Plant Record Tracking System:
IBM AT or compatible microcomputer with 640K RAM, hard disk drive, any printer, dBase III Plus.

To operate Module 2 - Mapping System:
Digitizer and mouse/cursor, two serial ports on computer, AutoCad compatible plotter, math co-processor chip for computer, hi-resolution graphics display capability, AutoCad Vs. 2.5.

OPERATION

Copy all Plant Record Tracking/Mapping diskettes into a sub-directory titled "Garden". This includes the dBase and AutoCad diskettes. Load in the drawing file of your garden. Enter the Garden sub-directory and type the command "Garden" and the program will start. The main menu will appear with choices that will lead you through all display, print, plot and edit options that give you a basic plant records system. Plant information entered into the system through the add option of the Edit Menu is stored in a dBase database file named Plantrec.dbf. The file is oriented around a unique accession number for each plant record. All information is variously indexed and available to the user in selected formats through the Display, Print, and Plot (with the mapping module) Options of the program. The user does not need to know how to use dBase or AutoCad, nor do they need to remember sets of commands or sequences of keys. The menu leads one through the plant record tracking system with little more than picking a number or typing in plant information or pressing the return (enter) key on the keyboard. This system was prepared for a specific institution, so data is entered according to their format. Accession numbers are in a format 870001, 870002, 880001, 880002, etc. The first two digits of the accession number represent the year of accession and the last four digits represent the number of plants accesssioned within that year. The map of the garden (figure 7) had the option of being digitized or scanned into the AutoCad drawing format. Scanning was chosen because of the existing high quality map. Touch-up by digitizing was required to ensure accuracy. Digitizing also separates onto individual layers topographic lines (figure 8), trees, buildings, walls and features. Quadrant lines were created on a separate drawing layer based on an 80 foot square grid and ordered with letter and number i.e. A1, A2, B1, B2, etc. (figure 9).

The mapping section is the only section where a few words are needed to explain procedure. After adding records (in Edit menu) or deleting records, the choice "Update Graphics" must be chosen to update your map. The program automatically changes over to AutoCad, loads your garden map, and brings the quadrant(s) to the screen so that you may use the cursor to locate the exact position of the addition or deletion. Hit the return key when the position is found, and the operation is performed and you are prompted for the next addition or deletion if there is one. It is necessary to exit (quit) properly as prompted from all sections of the program.

The main benefit of this system is its ease of use combined with the ability in time to go beyond its simple procedures and manipulate your data in the thousands of ways possible using dBase and AutoCad directly. Your data is already resident in their programs. No conversion is necessary. Press the escape key and you are in the dBase program directly. What could be more simple?
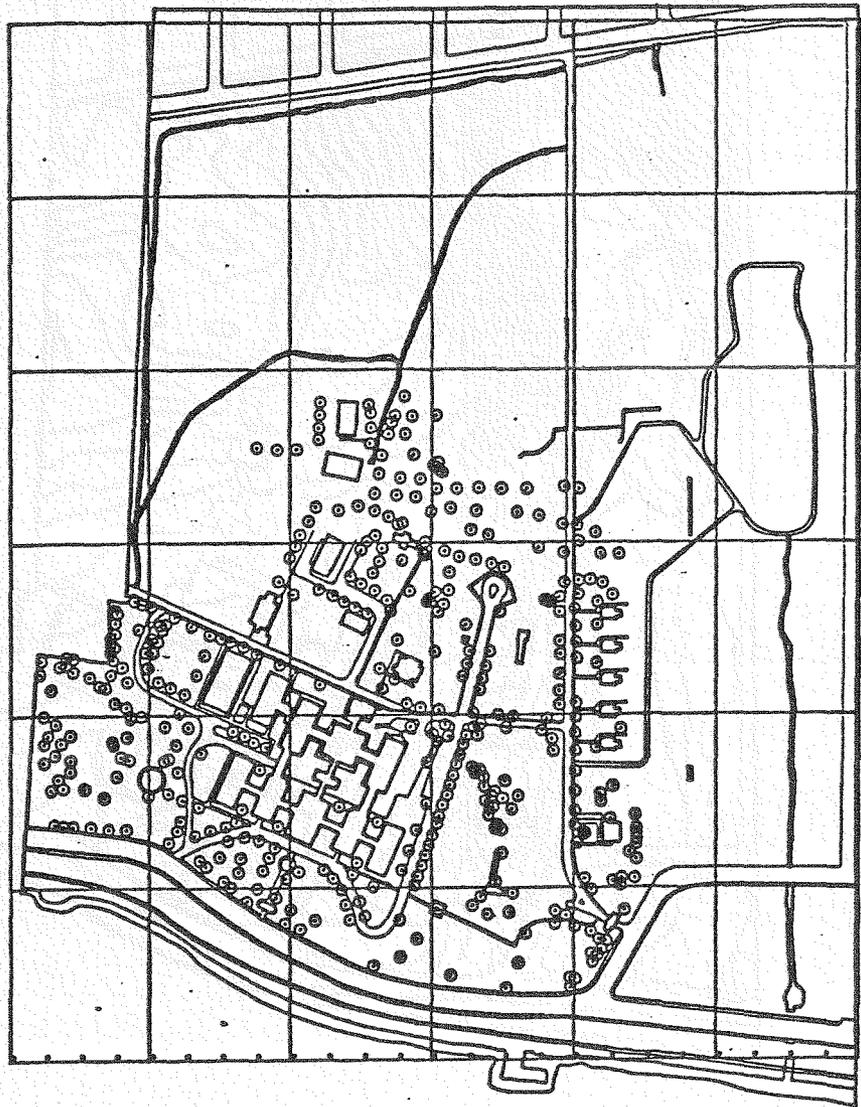
FIGURE 7. Map Detailing Tree Insertions
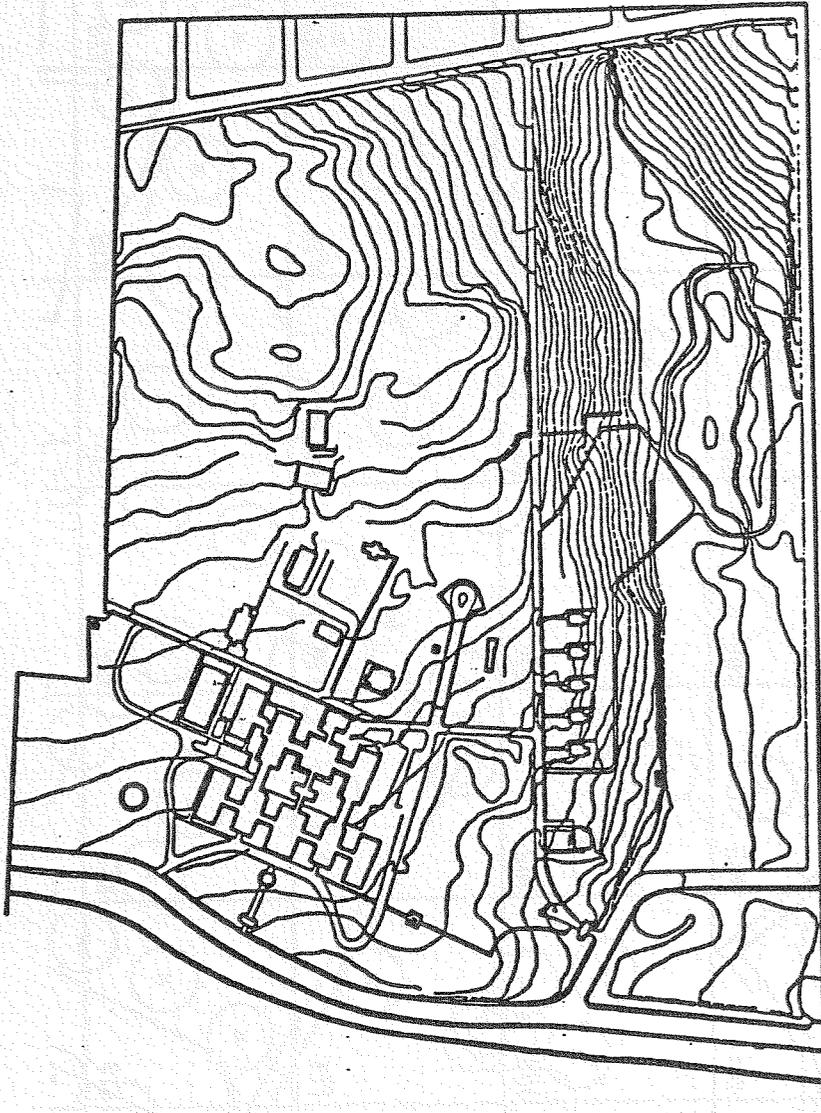
FIGURE 8. Map Detailing Topographic Lines
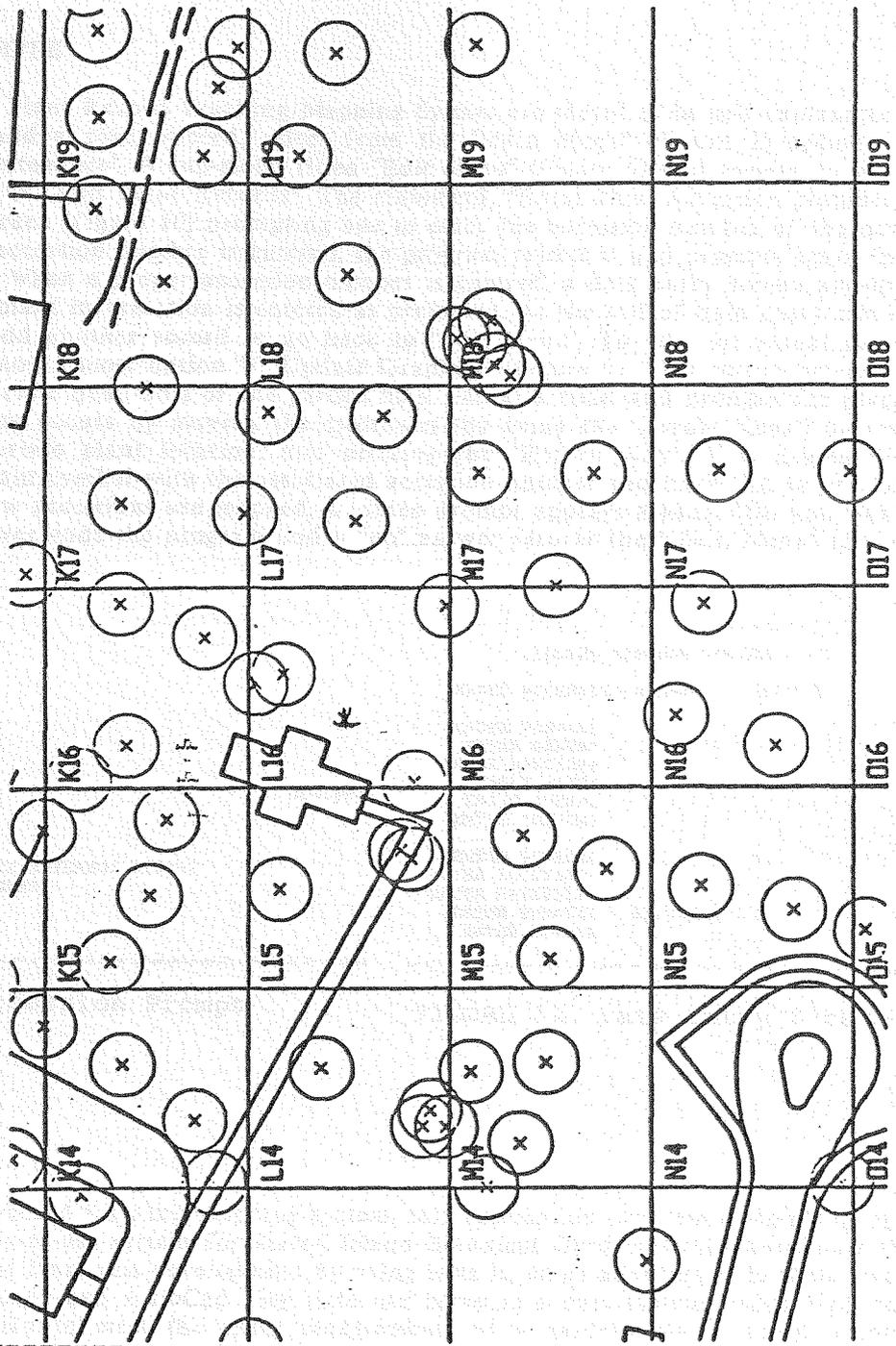
FIGURE 9. Map Detailing Quadrants

DATA ENTRY EXAMPLE

All operations in the Plant Record Tracking/Mapping System are meant to be self-explanatory via the menus. To add a plant record, select from the "Main Menu" (figure 2) option "4. Editing and File Maintenance". A sub-menu titled "Edit Menu" (figure 6) will appear on your screen. Select option "A. Add Plant Records". The statement, "Enter New Accession Number:" will appear on the screen (figure 10) prompting one to enter the accession number of the new plant. If an existing accession number is entered, the program rejects it and prompts again for an accession number. When a proper accession number is entered, a data entry screen appears (figure 11) to which plant information is entered as prompted. At the end of data entry one is prompted to either add another record or go back to "Edit Menu". To add the actual plant location to the map, now choose option "F. Update Graphics" (figure 6). This option brings to the screen the appropriate quadrants of the garden map, one at a time, and prompts for plant location. Plant location occurs by moving the crosshairs (by using the "Arrow Keys") on the screen to the appropriate plant location, and pressing the "Return Key". This causes the program to draw a plant symbol with the associated accession number and store this as part of the map. When all new accessions are mapped, a screen prompt appears asking, "Do you want to quit?" A "yes" answer ends the program and a "no" answer returns the "Main Menu" to the screen.

```
                                            ADDING RECORDS SCREEN

                                       ENTER ACCESSION NUMBER:     870012

                                       ENTER FAMILY:
                                        ENTER GENUS:
                                      ENTER SPECIES:
                                         ENTER RANK:
                        ADD.prg           ENTER SUBSP:
                                        ENTER COMNAM:

                                       ENTER SOURCE:
 LAST ACCESSION NUMBER ENTERED: 870011 ENTER LOCATION:
 ENTER ACCESSION NUMBER:               ENTER NATIVITY:
                                        ENTER UPDATE:     01/01/00
                                         ENTER NOTES:
```

FIGURE 10. Accession Prompt   FIGURE 11. Data Entry Screen

SUMMARY

As a prototype plant record tracking/mapping system, this application program attempts to set an example of an easy-to-use system for Staten Island Botanical Garden. Other horticultural institutions can benefit from this development by using it as is, or by adapting it to their own needs. The dBase III code and AutoCad Lisp code can serve as a base system which a dBase programmer can modify to meet the exact requirements of a gardens plant record needs. Customizing an existing program should cut development costs and times to a minimum. Price cuts in microcomputer systems have made it possible to own for less than $7,000 a basic microcomputer system capable of running this program. Finally, at this time, it is feasible for most gardens to avail themselves of the benefits of computerized plant record tracking/mapping.