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Proc. Fla. State Hort. Soc. 100:93-95. 1987.

CITRUS SURVEY AND CITRUS MAPPING MICROCOMPUTER PROGRAMS

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Additional index words. citrus inventory, grove counts, data collection .

Abstract. **Citrus Survey and Citrus Mapping Microcomputer programs are examples of software designed for field use.**

Citrus Survey is a microcomputer program designed to collect tree data in the field and store this information as a computer file. A user can gather any information, including varieties, rootstocks, tree size or tree condition using the laptop microcomputer, TRS-80, Model 100. The field information is printed in two parts: statistical report of the grove and a map of the trees using a companion program, Citrus Mapping.

The Citrus Mapping Program has several options when printing a grove map. First, the map can be printed in the same direction as mapped in the field or the map can be rotated with North at the top of the page. Second, the user may select all of the information used to describe the trees in a grove to be printed or the user may arbitrarily select only portions of the information to be printed. Third, the user can select maps to be printed on 8½ inch or 14 inch paper.

Citrus Survey is written in TRS-80, Model 100 Basic. Citrus Mapping is a microcomputer program written using DOS 3.3 for Apple and MS-DOS for IBM computers or equipment compatible with either of the above.

The techniques of grove mapping and the advantages associated with an up-to-date tree inventory have been described in detail (1, 4). The traditional method was to record tree data on graph paper or a suitable substitute. With the introduction of aerial color infrared photography Blazquez et al. (3) recorded tree data in the field on a clear acetate placed over a photographic enlargement of a grove. Thet mapped random sections of a grove and used the information to verify aerial photo-interpreted maps. Barros et al. further developed this technique by recording tree data in the field with a BASIC program written for a Times/Sinclair 1000 microcomputer (2).

The effort to develop software for grove mapping evolved from a critique by a group of citrus managers of an aerial color infrared (ACIR) photography project of 1000 acres in north-central Polk County. The group consisted of Robert Kerr, Vice President, Grove Care, Harvesting, and Fruit Procurement, Holly Hill Fruit Products, Inc.; Bill Manual, formerly Director of Operations, Haines City Citrus Growers Association; Erroll Fielding, Grove Manager, Orange-Co, Inc.; and John Husted, Production Manager, Waverly Growers Association. They agreed that the ACIR photography project was successful in providing accurate information on tree condition and stress. The group wanted to expand the project to include mapping of trees by variety. An accurate tree count by variety was important to all four organizations because of their fresh fruit markets. To schedule harvesting crews, an estimate of available fruit depended upon an accurate tree count by variety.

In 1983, the author agreed to develop software to collect tree data in the field and the group of four fresh fruit organizations agreed to share the cost of the portable computer and accessories.

Materials and Methods

Grove data was collected in a ground survey with a TRS-80 Model 100 portable computer containing 32 kilo bytes of random access memory (RAM). Other accessories included a Radio Shack computer cassette recorder, computer cassette tapes, a recorder-to-computer cable and RS-232 cable.

The data was transferred to both an Apple II series computer and an IBM compatible Zenith using a RS-232 cable connected to a serial interface card. ASCII Express telecommunications software was used to transfer the data. IBM or IBM compatible computers were equipped with a null connector attached to the RS-232 cable in addition to telecommunications software, such as ASCII Express, Tandy's Desk-mate or Procomm.

The software was written in BASIC and divided into two parts. The data collection or Citrus Survey Program was stored on cassette tape and the data presentation or

Citrus Mapping Program was stored on 5 1/4 inch floppy disk.

The Citrus Survey Program was written to conserve as much memory space as possible. For example, if a large number of trees were to be mapped the program could be configured to map a single grove containing approximately 5,300 trees. Likewise, the program could be configured for six groves with 1,384 trees in each if a large number of groves with a relatively low planting density were being mapped. Any number of groves could be selected within the one to six range with a corresponding decrease in the maximum number of trees that could be mapped. This feature determined how many groves could be mapped before the data was transferred to cassette tape or the data was uploaded to a microcomputer. The user had to decide the manner in which trees would be described. The labels that described the trees were customized as were the single keyboard letters or numbers used to identify those labels. In figure 1, a Duncan grapefruit block was mapped using the following customized keyboard characters and descriptive labels: "G" for Mature gft, "Y" for Young gft, "X" for Skip, "F" for Frozen, "V" for Valencia, "T" for Tangerine and "R" for Ruby gft. As many as 15 labels could be used as necessary to describe various grove characteristics.

The software used the "ENTER" key to terminate the current tree row and start the next row. At the end of the row a U-turn was made and the next row was mapped moving in the opposite direction. Rows could contain any number of trees but the number of rows was limited to 66. A single row was mapped with each pass. The display on the screen contained the direction of travel, the row number and the current tree position.

Some irregular groves could be mapped easily. To take advantage of this subroutine, mapping was begun from a side of the grove that was uniformily planted. This allowed a baseline to be established along which all trees originated in the same relative position without regard to the exact number of trees in each row. Unplantable areas within a grove, such as a cypress pond, presented a different problem because a given row existed on both sides of the unplanted area. To map this type of planting upon reaching the unplanted area, an appropriate number of spaces was entered using the space bar on the Model 100 keyboard to span the distance to where a particular row resumed. A blue-line map would be especially helpful in such situations. The space bar was used in the program to represent an unplantable space and as such was not counted in calculating net planted acres. A specific keyboard character was selected to represent empty sites that could be planted.

Another subroutine provided the user an option to create new labels after mapping had begun. The user then had a method to create an additional label for either a tree previously overlooked or perhaps a permanent installation, such as an irrigation pump, fuel tank or wind machine. After a new label was created, mapping would immediately resume.

Once the mapping exercise was completed, the file was saved as a data file. If another grove was to be mapped, the user had the option of using the previously created labels or returning to a subroutine to create a set of new labels. If changes to the previous map were necessary, the user could recall that map and continue mapping where the file was originally terminated. Also, if errors were made, an edit subroutine provided the user the options of adding additional labels, changing or deleting labels.

The data files could be temporarily saved on cassette tape or transferred to a microcomputer using the Model 100's Telcom program.

The Citrus Mapping Program was designed to rearrange the data from files created by the TRS-80 Model 100 series portable computer. The printed product contained the basic grove information, a summary of tree counts, acreage and percentages for each label (Figure 1). The user had an option of printing the grove as mapped in the field or rotating the data so that North was positioned at the top of the page. The user selected the width of paper, either 8½ inches or 14 inches, upon which the map would be printed. The user's last option was to select whether all tree information would be printed or if only specifically selected labels would be printed.

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++                                                                          ++
++                                                                          ++
++                      CITRUS GROVE MAPPING PROGRAM                        ++
++                              DEVELOPED BY                                ++
++              POLK COUNTY COOPERATIVE EXTENSION SERVICE                   ++
++                   (813)533-0765, BARTOW, FL 33830                        ++
++                     COPYRIGHT(C) JANUARY 28, 1984                        ++
++                     IFAS - UNIVERSITY OF FLORIDA                         ++
++                                                                          ++
++                                                                          ++
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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

DATE:     02/22/86                              BLOCK:              DUNCAN

TIME:     16.35 HRS                             N-S SPACING:        30 FT

COMPANY:  OSWALT                                E-W SPACING:        30 FT

SURVEYOR: TWO                                   DIRECTION OF TRAVEL: E

COMMENTS: UPDATE TREE SURVEY                    MOVEMENT ACROSS BLK: N


                              GROVE STATISTICS
==============================================================================

  KEY   LABEL              ACREAGE        TREE COUNT        % TREE COUNT

  G... MATURE GFT           3.68            178.00              64.03
  Y... YOUNG GFT             .83             40.00              14.39
  V... VALENCIA              .39             19.00               6.83
  F... FROZEN                .56             27.00               9.71
  X... SKIP                  .25             12.00               4.32
  R... RUBY GFT              .02              1.00                .36
  T... TANGERINE             .02              1.00                .36

  TOTAL..............       5.74            278.00             100.00
```

Fig. 1. Printout with grove information and summaries of acreages, tree counts and percentages.

Results and Discussion

A number of growers cooperated with the Polk County Cooperative Extension Service in identifying programming errors and deficiencies. Thus, programming errors were found and corrected and several subroutines were added and/or modified. Several examples included the subroutine to estimate the maximum number of trees that could be mapped with a given amount of available memory, the subroutine to add new labels after a grove was created, and the ability to print maps on 8½ inch or 14 inch paper.

The map listed all trees in the grove by row and column number (Figure 2). If the map was wider than the paper width selected, the remaining portion was printed on the following page. Growers using the Citrus Survey and Mapping software found that mistakes were very easy to correct. If the first tree in a row of trees was overlooked, the

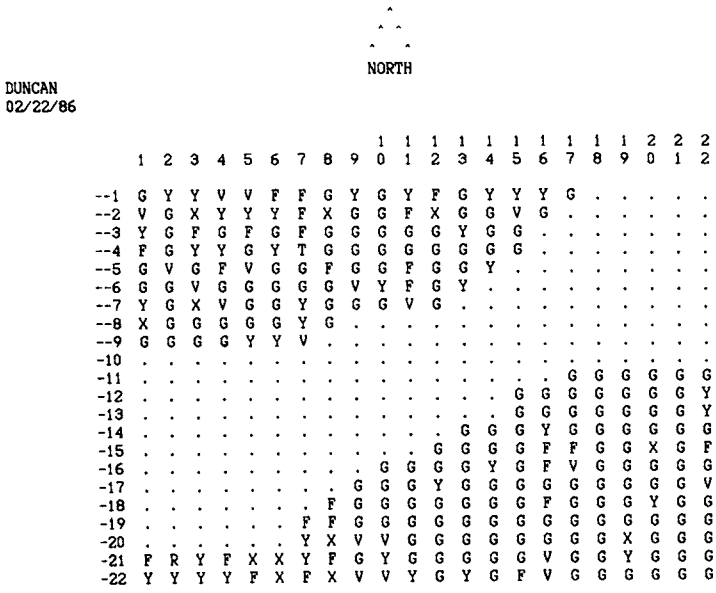

Fig. 2. Printout of grove map showing grove orientation, tree location, row and column numbers.

tree was inserted in position #1 with the computer. If the row was recorded on the graph paper, the entire row would have to be erased and re-recorded. The deletion of trees was also simple and quick. Computer mapping also eliminated the need to transcribe the map from a field copy to a file copy. Overall, growers found that computer mapping reduced the mapping time by 25% or more, while other growers who balked at mapping groves have mapped their entire holdings.

In conclusion, the Citrus Survey Program provided growers with an accurate and easy method to collect data in the field using a portable computer that was inexpensive and durable. Also, the Citrus Mapping Program which formatted the data files allowed growers to utilize a wide range of Apple, IBM and IBM compatible computers to print their grove maps.

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Proc. Fla. State Hort. Soc. 100:95-99. 1987.

GROVE MANAGEMENT WITH COMPUTER AIDED PHOTOINTERPRETATION

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Additional index words. color infrared aerial photography, data base, varieties, rootstocks, tree spacing, potential acres, planted acres, net acres, tree space acres, mapping.

Abstract. **Color infrared aerial photography of groves is useful in grove management. When photointerpreted information is entered into a data base of a computer, the results can be used as a management tool. Photointerpreters looked at 5 different tree statuses of citrus trees: 1 = missing trees; 2 = trees 1 to 3-yr-old; 3 = trees 4 to 6-yr-old; 4 = trees 7-yr-old and older; 5 = stressed, dying, and dead trees. Other information entered was grove name, block no., variety and code, rootstock and code, and tree spacing. This data was entered into an IBM computer using a custom data base program. Sums of tree statuses 1 and 5 were labeled potential acreage and sums of tree statuses 2, 3, and 4 were labeled planted acreage. A printout of the data base produced 4 reports: 1) sums for each class and totals by rootstock; 2) by variety; 3) by block, the tree statuses in the block are summed, along with total healthy trees, total potential trees, net total planted acres, net total potential acres, and total net planted to net potential acres; and 4) by grove, listing the sum of the tree statuses and total of all tree statuses.**

The photointerpreted results of sample blocks in an actual grove of large acreage, using color infrared aerial photography, computers, and a modified data base program, are reported.

Systematic mapping of citrus groves can provide an accurate account of tree conditions related to production, disease, and nutrition. Annual mapping can point to areas of change that may be trouble spots (1). Few industrial managers would attempt to manufacture a product without an accurate inventory. Yet, due to the difficulty in collecting citrus tree data, few citrus managers engage in resource mapping. Thus, citrus growers can only approximate grove condition by cursory inspection of the grove or by a change in production (6).

The Florida Agriculture Statistics Service has photographed the state's citrus production area every 2 yr since

Florida Agriculture Experiment Station Journal Series No. 8261.