dangerous interactions with other chemicals, storage and disposal, and any restrictions or tolerances. A connection to the Citrus Flash section notifies users of any recent changes in label registrations or in IFAS recommendations.

Citrus pests and their management. In addition to pesticide recommendations, this topic describes in detail the major citrus pests, their identification and biology. A general integrated pest management program discusses preventive measures, pesticide spray scheduling and use of field scouting. The major pest categories discussed are insects, mites, diseases, nematodes, weeds and vertebrate pests.

Cold protection. This describes various techniques for cold protection such as proper site selection, mechanical and cultural methods, irrigation, cover crop management and the importance of maintaining proper pest control and plant nutrition. Use of remote sensing and freeze forecasting in cold protection management are described. Freeze damage loss appraisal as well as minimizing and recovering from freeze damage are also described.

Economics. This central topic has a high degree of interrelation with the other sections. It includes grove establishment and maintenance care costs, tree replacement costs, equipment costs, taxes, depreciation, and loss appraisal. Individual cost programs and cost projections are outlined for the first 4 yr, and then for subsequent years for specific groves. Individual costs can be compared with historical trends and statewide averages.

Remote sensing. Various uses of remote sensing in cold protection, detection of pest outbreaks, tree-size control management, grove mapping and surveying are discussed.

Citrus agricultural statistics and information. This is a general information section on statistics of citrus production in Florida. It includes items such as trends in production levels and acreage planted, citrus growing regions and important organizations involved in citrus production.

Acknowledgements and user recommendations. An important consideration in design of FAIRS was giving visible credit to all participants. Contributor's names are listed throughout the database. This acknowledgements section gives special credit to the citrus crop coordinators. In addition, recommendations to users for operating the FAIRS citrus program are provided. Ways are given for users to provide comments and suggestions for improving the system.

The citrus database is an extensive body of information, and the outline presented here has room for virtually any topic of interest. This information can be shared by all groups within the citrus community, and as FAIRS evolves user's needs are constantly evaluated so the database content can be kept relevant. No such assimilation of information on citrus existed previously, and FAIRS should help introduce a new era of information delivery by the extension service.

Literature Cited

1. Beck, H. W., G. A. Marlowe, Jr., K. L. Pohronezny, and F. A. Johnson. 1983. Florida Agricultural Information Retrieval System; A computerized crop management program with application to tomatoes. Proc. Fla. State Hort. Soc. 96:128-130.
2. Jackson, J. L. and F. Ferguson, Jr. 1983. An experimental computer network for growers. Proc. Fla. State Hort. Soc. 96:5-7.
3. Johnson, F. A., H. W. Beck, and J. L. Stimac. 1981. Use of interactive large scale data bases for information delivery. Proc. Southern Region Ext. Plant Path.-Entomology Workshop (in press).
4. Stimac, J. L., J. W. Jones, and J. W. Mishoe. 1980. Design of a distributed computer network for Florida agriculture. AgComp Bul. 1:15-28.

Proc. Fla. State Hort. Soc. 96:5-7. 1983.

AN EXPERIMENTAL COMPUTER NETWORK FOR GROWERS

J. L. Jackson, Jr. and F. Ferguson, Jr.
University of Florida,
Institute of Food and Agricultural Sciences,
Cooperative Extension Service,
P. O. Drawer 357, Tavares, FL 32778

Abstract. **Computers have long been an important tool for large business operations. With the introduction of reasonably priced small computer systems in the mid 1970's a remarkable tool was made available to the small grower. The Lake County Extension office obtained an Apple II+ computer in March 1980 and has been developing software with the ultimate goal of delivering information directly to the grower. To this end a demonstration delivery network has been established and is known as LOIS (Lake-Orange Information System). Apple II+ computers, a Corvus 20 megabyte hard disc, and D. C. Hayes 1200 baud modems are the main hardware components that deliver various products such as radar and satellite maps, weather forecasts, temperature readings, insect and disease models, and messages to a group of 8 grower-users. The system is operational 5 days a week and is able to transfer information rapidly.**

Information must be placed in the hands of users to be of value. Many methods have been used in the past to provide citrus growers with a wide variety of information. Today's technology can provide data as it occurs, or with "real time" characteristics. Growers need thermal satellite maps that are only minutes old if the data is to be of value for cold protection. The same is true for radar maps showing location and intensity of rainfall.

A delivery system based on micro-computers has been developed to deliver real time data (Fig. 1). A network of growers utilizing computers has been established in Lake and Orange counties to provide users with timely information. This network has been designed to operate as a development or pilot system to test the value of rapid transmission of various products such as the satellite and radar maps. This paper will describe the equipment used, products disseminated, system operation, approximate costs involved, and future plans.

Equipment

The equipment used for the Lake-Orange Information System (LOIS) consists of the user's computer system and the extension office computers. Participating growers utilize an Apple II+ with a disc drive controller, and a Mountain CPS Multi-funtion card that contains a clock and serial or parallel interface capabilities. All growers have a D. C. Hayes 1200 baud modem for communication with the extension office main computer. Most have an Apple III monitor and use a conventional color television for those products that utilize color graphics for display (satellite and radar maps).

The extension office also uses the Apple II+ computer

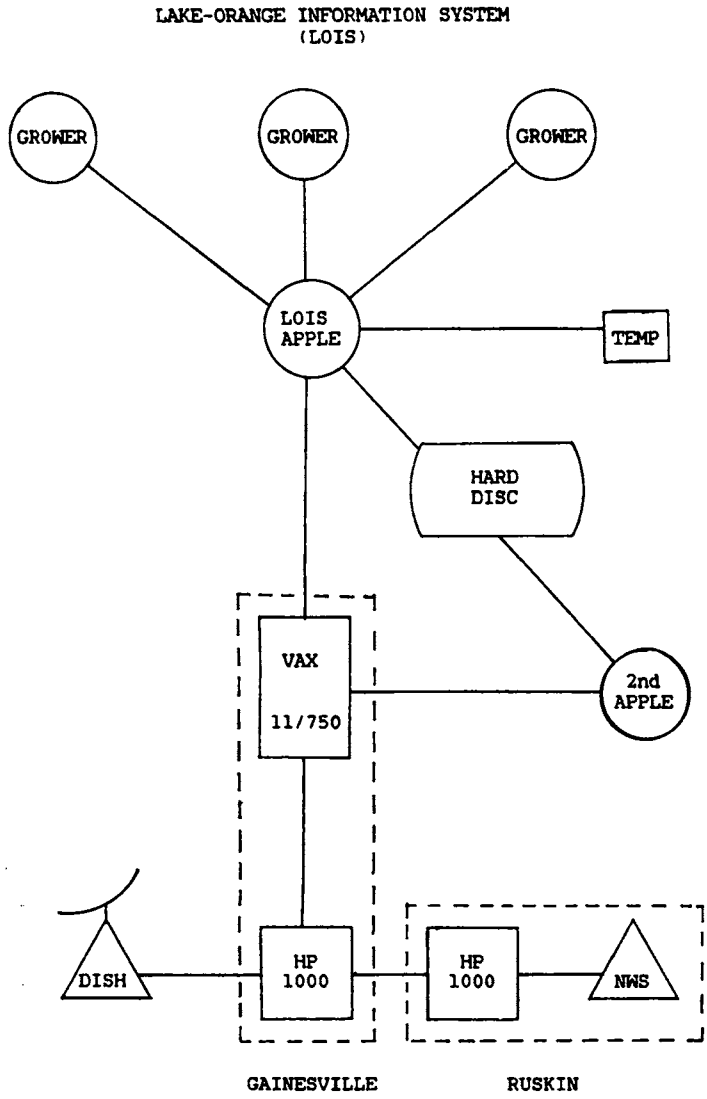

Fig. 1. Lake-Orange information system (LOIS).

which is dedicated to the network full time and has an additional 16 Kilobytes of memory, the Mountain CPS Multifunction card, and a special card that allows the computer to collect 2 temperature readings. The D. C. Hayes modem is also used for communicating with growers over a separate telephone line used only for LOIS. A Corvus 20 megabyte hard disc provides storage as well as operating information for the system.

Products

Growers receive information in 2 different methods although the same equipment is used and most do not even realize there is a difference. The first group of products available to the grower are obtained with the Apple II+ operating as a "dumb terminal". This simply means the computer functions as a typewriter and display screen. In this mode it cannot process or store data, but can transfer information to a printer. The specific products handled in this manner are given below with a brief description of the contents:

Agricultural weather forecasts. Farm forecast issued daily by the National Weather Service from Ruskin. Two bulletins are prepared each day at 6:30 AM and 6:30 PM. The early morning forecast is used for LOIS.

Temperature and humidity. A special board in the Apple II+ is able to read two thermistors continuously. One of these readings is a wet bulb value and is converted to relative humidity. Hourly these readings are stored on the disc as the highest and lowest temperatures for the hour as well as the relative humidity at the time of storing the data. Growers can obtain historical values or current readings.

Greasy spot index. This is a developmental model that relates temperature and humidity to infection by the greasy spot fungus on citrus. Since the model is in a developmental stage this value is given only to obtain additional data from growers and test the delivery method. A similar product for rust mite is currently being refined and should be available soon.

Messages. Growers also have the opportunity to check messages left for them concerning meetings, operation of the system, etc. They in turn can leave a message when signing off. At the present time the messages are available to all users with no attempt for an individual "mail" service directed to specific users.

The other products are handled differently by the grower's computer. In order to receive, store, and process satellite and radar maps software has been written to provide communication between the grower's Apple II+ and the one located in the extension office. The computers exchange information utilizing the hard disc to provide the following products.

Thermal satellite maps. The maps are collected and processed in Gainesville by the Department of Fruit Crops (2). They are available routinely, but on freeze nights the extension office obtains one every hour for distribution.

Radar maps. These maps are also obtained from Gainesville and have been picked up directly from the National Weather Service office in Ruskin. The information is taken from observations by NWS personnel.

Another product is available to growers through LOIS, but requires a data buffer. This is the FAIR (1) system, which is a large data base of information on several crops including citrus. At the present time the citrus section is still being developed and when completed will include a wide variety of topics such as insect and disease control, rootstocks and varieties, weed control, pesticide labels, and many more. As more information is added to the FAIR data base the demand should increase and many of the users will purchase the additional hardware to obtain material.

Operation

The system operates on a routine basis 5 days a week, 24 hr a day. During freeze situations LOIS will be running continuously. Growers can select the automatic operation that will routinely call and collect the thermal satellite maps or under normal conditions operate manually and obtain data whenever desired. Presently there are no time constraints on the users except in freeze situations. During these critical times the automatic mode allows the most efficient use of LOIS.

Operation in the extension office is highly automated using scheduled calling times to acquire most data. The Apple II+ that is dedicated to LOIS is on-line from 5 min after the hour until 5 min before the hour. During the 10-min time interval data collection takes place. The thermistors are read for the hourly temperature and humidity readings. Radar maps are obtained at 8:00 AM, 10:00 AM, and 2:00 PM and the Agricultural Weather forecast is collected at 8:00 AM. The greasy spot index is entered manually once a day and messages are up-dated as needed. On freeze nights the operation changes with the increased

demand for products. A second Apple II+ is used to collect satellite maps on the half hour while LOIS continues to handle incoming calls and read temperatures.

All communication takes place over single service (private) telephone lines using the D. C. Hayes 1200 baud modem. Radar maps, satellite data, and the agricultural forecast are transmitted from a VAX 11/750 multiuser computer in Gainesville that has received the information from the Department of Fruit Crops, Climatology section (2).

During the 1982-83 winter season 4 growers had all the necessary equipment to access the system. These growers averaged 13.6 calls in a 24-hr freeze situation. These calls were made automatically to obtain thermal satellite maps.

Costs

Since the entire computer field is changing rapidly it is difficult to assign firm costs. Only "ballpark" figures will be used based on January 1983 prices. The grower's system consisting of an Apple II+ with disc drive controller, monitor and CPS card plus the modem and color television was approximately $3,000. The extension office has the same equipment as the grower plus the hard disc, the temperature card, and an extra 16 Kilobyte memory board for a total price of approximately $9500. No communication costs or software development expense are included in these figures.

Future Plans

The LOIS network acts as a developmental tool to test various products. The short term goal is to demonstrate that valuable information can be rapidly and efficiently disseminated through a computer network. The primary concern of the Lake County Extension office is to place valuable usable products into the hands of growers. LOIS has already shown that a computer delivery system can provide useful products in a timely manner.

The long term goal for LOIS is not to expand the system, but to continue to operate as a development system to field test various products then turn them over to larger networks that utilize large mainframe computers with multi-user capability. LOIS has been a valuable tool to demonstrate what can be done with computerized delivery systems and in the future will play a major role in testing products to be delivered to growers. The ultimate goal of the entire effort is to provide growers with additional information so that they can do a better management job resulting in greater profits.

Literature Cited

1. Beck, H. W., T. R. Fasulo, J. L. Knapp, and D. P. H. Tucker. 1983. The Florida agricultural information retrival system: a complete crop management program with application to citrus. Proc. Fla. State Hort. Soc. 96:3-5.
2. Martsolf, J. E. and J. F. Gerber. 1981. Florida satellite frost forecast system documents freezes of January 1981, and is refined for future seasons. Proc. Fla. State Hort. Soc. Soc.94:39-43.

Proc. Fla. State Hort. Soc. 96:7-11. 1983.

AN ECONOMIC ANALYSIS OF IRRIGATION SYSTEMS FOR PRODUCTION OF CITRUS IN FLORIDA[1]

D. S. Harrison, A. G. Smajstrla, and F. S. Zazueta
Agricultural Engineering Department,
University of Florida,
Gainesville, Florida 32611

Additional index words. crown flood, trickle (drip and spray-jet) irrigation, permanent overhead, traveling guns, sprinkler.

Abstract. **A study of citrus irrigation systems, designed by irrigation industry dealers and installed in commercial citrus groves, was conducted in 1981-82. Systems studied were trickle (drip and spray-jet), crown flood, permanent overhead and traveling gun sprinkler systems. Irrigation system types, characteristics, inital, fixed and operating (variable) costs are presented. Annual costs per acre for crown flood, drip, spray jet, permanent overhead sprinkler and traveling gun systems analyzed were $36, $57, $159, $210 and $224, respectively.**

The use of trickle systems for irrigation of citrus and orchard crops has escalated rapidly in Florida in the last 8 to 10 yr. Irrigation utilizing permanent overhead sprinkler systems and traveling gun sprinkler systems slowed considerably during the same time period. Primary reasons for these changes have been: 1) to reduce the cost of irrigation, 2) to reduce water usage, and 3) to obtain cold protection for citrus.

Costs of irrigation have also changed dramatically in recent years. An economic analysis of systems used for citrus irrigation was made by Reuss and Harrison (10). At that time the predominant systems were: 1) permanent overhead sprinklers, 2) self-propelled (traveling) guns, 3) portable high pressure guns, and 4) perforated pipe sprinklers. Total annual costs (fixed and variable) per acre ranged from $59 to $73 or about $5 per acre-inch of water applied. At today's prices, costs for permanent overhead and traveling guns are over 4 times greater at $210 and $224 per acre, or about $23 to $25 per acre-inch.

Trickle irrigation systems (drip and spray-jet) offer the advantages of both lower initial and operating costs as compared to permanent sprinklers and traveling guns. They operate at much lower pressures and thus reduce fuel consumption. They are also easily automated. Thus, they reduce labor costs as compared to portable systems, which have dramatically decreased in numbers due to high labor costs.

Trickle systems reduce water usage for citrus and orchard crop production, primarily because they reduce waste during applications. Water is placed into or very near the crop root zone, thus reducing evaporation and wind drift losses. When properly managed, trickle systems minimize losses due to deep percolation or lateral flow that would occur with seepage and crown flood irrigation systems. They also apply water at low flow rates, thus allowing less productive water sources to be used, such as when sources are too limited for seepage or crown flood irrigation.

An additional major advantage of spray-jet irrigation

[1]Florida Agricultural Experiment Stations Journal Series No. 5118.