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## SCAMP- A Computer-Based Information Delivery System for Cooperative Extension

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### INTRODUCTION

The need for rapid transfer and analysis of pest, crop, and weather information was defined by the Integrated Pest Management Program at Cornell University during the formative years of the program. Many other states had defined similar needs and at least one state, Michigan, had implemented a computer-based information system entitled PMEX (1) in 1975.

In 1977 the Integrated Pest Management Program requested and received support from the Extension Director and the Experiment Station Directors to initiate a computer-based information system, and basic ideas for such a system were obtained from Michigan State University. In early 1978 a system became operational under the name SCAMP, an acronym for System for Computer-Aided Management of Pests. During its first year of operation, SCAMP linked the New York State Agricultural Experiment Station at Geneva, the Cornell University Campus, seven county extension offices, and the IPM field personnel together for data and information exchange. Each participating county extension office was provided a computer terminal through funds appropriated by the Extension Director. Terminals at the college facilities were purchased through department and program funds.

The information system was based in the New York State Agricultural Experiment Station computer center at Geneva which had just installed a Prime (2) computer. The system was designed to be interactive, i.e., information and data could be sent and received in a conversational manner, and its structure allowed new application programs to be easily implemented.

New application programs were added to SCAMP each year, and the number of SCAMP users increased each year. The system was originally designed for research and extension faculty and extension agents.

At the present time, SCAMP links 27 county extension offices, the Long Island Research Laboratory, the Hudson Valley Laboratory, and the plant protection departments housed on the Ithaca and Geneva Campuses (Fig. 1).

Other SCAMP users include growers, fieldmen, technical representatives of the agricultural chemical industry, extension specialists in neighboring states, the N. Y. Department of Agriculture and Markets, the N. Y. S. Crop Reporting Service, and the N. Y. S. Department of Environmental Conservation. In 1980 there were 167 individuals with SCAMP accounts. Present policies do not attach fees to SCAMP accounts, nor do they restrict the private sector from using the system. However, users other than those at Extension facilities must provide their own terminals and pay phone charges to reach the Geneva computer.

### PRINCIPLES BEHIND SCAMP

During the development of SCAMP, certain principles were kept in mind. These principles address both the characteristics of the user and his informational needs.

#### A. User Risk/Benefit

We realize that the use of SCAMP has several hidden costs. It requires the learning of new methods of communication and new work habits; it leads the user into suffering some novel frustrations, (can't access the computer, another manual to understand, more typing to do). Because of these costs few people in the agricultural community would use SCAMP unless there was something different about the information on the system.

#### B. Timeliness of Information

Information presented over SCAMP must be timely. If a user can obtain the same information as quickly by mail or by reading a newsletter, there is no need for him to use SCAMP. The information must also be relevant, a user concerned with tree fruit should be able to receive that information without wading through reports for other commodities.

#### C. System Flexibility

Information needs differ considerably among users

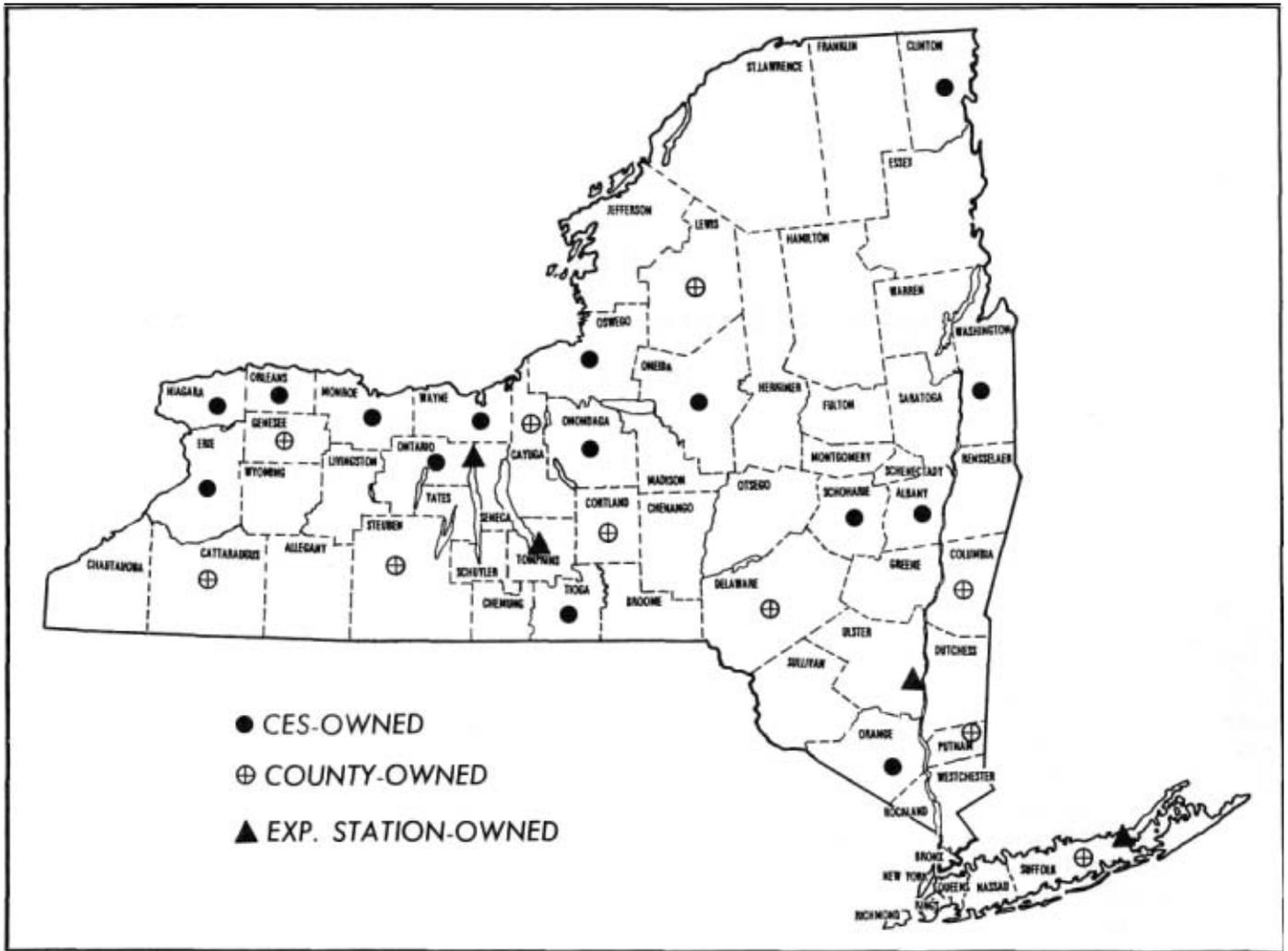


Figure 1.—Counties with computer terminals—1981.

depending on their responsibility, expertise, and location. Users are widespread, with locations in 27 New York counties and in nearby states. These people may also be expected to access the system at all hours. This is especially true of extension specialists and field technicians who are often only in their offices in the early morning or late evening.

#### D. Friendliness to User

Users of the SCAMP system include county agents, secretarial personnel, extension and research technicians, extension and research faculty, and graduate and undergraduate students. Educational levels range from a high school diploma to a Ph. D. degree with considerable academic experience. Computer experience ranges from none to considerable with relatively few users at the experienced end of the spectrum.

Given the above user characteristics, it is apparent that the SCAMP system must operate in English with little or no intrusion of "computerese" into its operations, and that it must be self-contained and internally consistent. Ideally, the fact that SCAMP is computer-based should be irrele-

vant to the user. In the same way that placing a telephone call requires no thought of the miles of wire and hundreds of switches used, using SCAMP should require only the understanding of a few simple procedures.

In order to maintain this "transparency" of the computer system, programs are required to conform to certain rules.

1. All programs are foolproof. The only way that a user may terminate a program is by typing "END"; any invalid entry is detected by the program and must be corrected by the user.
2. Each time user input is required, a question describing his choices is displayed (e.g. "ENTER COMMODITY-GROUP, ALL, HELP, OR END") followed by a prompt sign ("=> ") on a new line.
3. A "HELP" option is ordinarily available which further explains a user's choices.
4. A user's manual is available to explain the use of each program in detail.

#### E. Quality Control

In addition to the procedural rules discussed above, we

try to insure that the information delivered over SCAMP meet certain qualitative standards. We require that information be accurate by allowing only authorized users to input News, Library, and Strategy information and by having specialists check all weather data and model output.

## **F. System Maintenance**

If problems arise with SCAMP, consultation with the central staff may be difficult due to the geographic and time problems mentioned above. At the same time, rapid solution of problems is a necessity for two reasons. First, excessive time delays are unacceptable if the information is to be used effectively for extension purposes. Second, it is important to minimize frustration on the part of users in order to maintain their confidence in the system. It is not realistic to believe that extension users should be trained to raise their frustration thresholds to cope with problems such as errors in input or program malfunction.

## **IMPLEMENTATION**

As is true for all computer systems, SCAMP implementation can be thought of in two phases: hardware selection and software development. The hardware selection is by far the easier phase of implementation, and, unfortunately, it often receives more effort in the planning stages. Hardware selection is essentially a one-time process, whereas in a dynamic, expanding system like SCAMP, software development as well as documentation and training are on-going processes.

### **A. Hardware**

The hardware on which SCAMP was implemented was a Prime 300, later upgraded to a Prime 400. Initially, users linked to SCAMP through 15 terminals in the plant protection departments at Geneva and Ithaca. Seven printing terminals were available to Extension Agents and IPM field staff from April through September. These seven terminals were shared with the Agricultural Economics Dairy Programs which utilized the terminals from October to April. In succeeding years, several additional terminals were purchased by Cooperative Extension for use in county offices. At present, counties are encouraged to purchase their own terminals, and 10 counties have done so as of this writing.

Most users access SCAMP across telephone lines. This initially placed a financial burden on users who had not prepared for the expense in their budget requests. In order to encourage use of SCAMP during the 1979 season, county extension offices were called from Geneva and linked to the computer. This was continued until 1981, when a toll free number was installed at Geneva. At the present time, a user can choose several routes to reach SCAMP across telephone lines.

In the first year of operation, four telephone ports were available on the Prime for SCAMP calls. A fifth port was

added in 1979. During June of 1980, the telephone connections to SCAMP used an average of 20 per cent of the telephone capacity of the computer. During peak times the phone system was overloaded.

### **B. Software**

Software (computer program) development reflected our changing perceptions of the needs of the SCAMP user community. Early in the development of SCAMP it became evident that restrictions on program use and availability were necessary. Most programs are available to all SCAMP users. Other programs, due to their experimental nature (e.g. a model still being validated), are restricted to a few select users but are still listed in the SCAMP Manual and Index. Some programs are for data input by the central staff or make such large demands on the computer's resources (i.e. are very slow) that they are accessed through SCAMP but are not listed in the manual or index and will be referred to as background programs.

Software development can be divided into six areas: Executive program, Data collection, Electronic mail, Weather programs, Models, and Reference programs. All programs use either the Fortran or the Info (3) programming language.

A chronology of program development is given in Tables 1 and 2, a description of each program is given in Appendix One.

#### **1. Executive Program**

The basic structure of the SCAMP system is embodied in its executive program, NYMAIN. This program, much like a computer operating system, regulates a user's access to SCAMP programs.

Before anyone can access SCAMP, he must first be authorized. When a user begins his SCAMP session, the executive checks the list of authorized users and records his authorization codes for use by other programs: if he is not authorized, he is logged out.

With this mechanism, access to SCAMP programs and to the entire system is controlled. One of the background tasks is the maintenance of the authorization list.

Once a user's authorization has been checked, any messages sent to him by name are displayed. Messages are also displayed when he re-enters the executive program after using one of the other SCAMP programs. The user is always returned to the executive at the end of each specific program.

The executive program also asks the user for the next program he wants (WHAT WOULD YOU LIKE TO DO NEXT?), and runs that program. Each legal response is written to a file, which is later summarized by an accounting program to monitor usage. When the user is finished with his session, he merely types "END" and the executive program logs him out.

The executive program was the first SCAMP program developed. Since it is entirely independent of the application programs that are accessed through it, it is not necessary to change it to add programs to SCAMP.

Because of this, we believe that it will be possible to use the same executive program for an indefinite length of time.

## **2. Data Collection**

Data collection programs are those through which data from a particular project are entered for eventual summarization. In 1978, two data collection programs, one for pheromone trap catch data and another for tree fruit spray records, were included among the general SCAMP programs. A number of problems soon developed with the quality of remote data entry, and, in succeeding years, these functions were relegated to the status of background programs.

## **3. Electronic Mail**

The first program designed for SCAMP was an electronic mail program. We considered electronic mail to be the most important service we could provide. Unlike the telephone or the U. S. Mail, which only communicate with a single point, electronic mail communicates directly with a specific person. A telephone call only goes to a specific point at a specific time; and one then communicates with whomever happens to answer. During the growing season, agricultural workers are rarely near their phones. Electronic mail messages, however, are addressed to a specific individual and are available at the recipient's convenience and at any location containing a computer terminal.

The electronic mail programs are the most used in SCAMP. In 1980, these electronic mail programs accounted for 55 per cent of all program usage.

The electronic mail programs permit the timely distribution of information among users. This information falls into three classes: communications between individual users, reports of field observations, and summaries and interpretations of field reports and other current information. Originally, all messages, both personal and general, were received automatically by other users. As a result, many users complained of receiving unnecessary and irrelevant messages.

To ease this problem, in 1979 general messages were sent to display programs which displayed selected messages at a user's convenience. Reports of field observations (e.g. "Sighted first Potato Leafhopper, June 5") were sent to the program FIELD. Summaries and interpretations of events (e.g. "Leafhoppers sighted in Orange County, expect them in Clinton County by June 20") were sent to NEWS. Pest management strategies (e.g. "When leafhopper counts reach 100 per 100 sweeps, begin spray program") were sent to STRATEGY. These programs can be thought of as providing an electronic bulletin board at which one can browse at leisure.

Another feature of the electronic mail section is the program SUGGEST which serves as a suggestion box by sending user suggestions to the central staff.

All messages sent over the electronic mail programs are copied to an accumulated message file. In order to monitor system activity, the SCAMP staff prints out all messages weekly and copies them to a background file.

## **4. Weather Programs**

The weather programs are the second most frequently used class of programs in SCAMP.

Weather is the most important factor influencing agricultural events. Thus, timely, accurate weather data are essential.

Weather data are available in three forms. A verbal forecast obtained from the NOAA weather wire can be displayed for each of the 16 forecast zones in New York. The degree day totals for the current season at New York weather stations can be displayed. In addition, historical degree days for any period from 1900 to the present year can be calculated using Geneva's weather data base, and raw weather data for any portion of the current year can be obtained for any of the 40 participating weather stations.

In order to get the weather data into a usable form, the SCAMP staff must perform several background operations daily. The verbal forecast texts must be edited to eliminate typographical errors, and then must be transferred to the FORECAST programs. The temperature data that is used must be transferred to the appropriate files, and a weather specialist must check the data to insure that it is correct. In addition, the weather data is cross-checked against printed records monthly.

## **5. Models**

Models make predictions of biological events based on weather data and other environmental conditions. Models present one type of information which is not easily obtained from non-computerized systems.

Until 1980, when large scale weather information became available from the NOAA weather wire, the only models on SCAMP were limited in scope. The three models now available are:

### **1. BLITECAST(4)**

BLITECAST models potato late blight using hygrothermograph data and rainfall measurements from the field it is modeling. The model, which was developed at The Pennsylvania State University, predicts the incidence of blight and suggests a spray schedule. BLITECAST is a "local" model in that its predictions cannot be generalized for a larger area.

### **2. WEEVIL**

WEEVIL is a model of the development of the alfalfa weevil. It uses max/min temperature data from NOAA weather stations. Its output is examined by an alfalfa specialist and then a program is run to produce a map of the weevil's expected development over five regions in New York. WEEVIL is a 'global' model since its predictions have been successfully applied to large areas.

### **3. PETE (5)**

PETE is a generalized model of insect phenology which uses max/min temperature data to predict the development stage for 10 different insect pests. PETE is still an experimental model as we are trying to determine the accuracy of its predictions. Its use is restricted to SCAMP staff and the researchers working to validate it.

## 6. Reference

Reference programs present information which changes slowly and is on SCAMP principally for the convenience of SCAMP users. Unlike the information on the electronic mail programs FIELD and NEWS which is erased after 7 days, reference information remains permanently available.

Currently there are two reference programs available to SCAMP users.

LIBRARY serves as an on-line library of pest control and agricultural information. Its subject matter is divided up into several texts, each of which is the responsibility of a single support individual. Information includes pest control recommendations, monitoring techniques, pest life histories, notification of special phenological events, and the latest pesticide labels from EPA and New York's Department of Environmental Conservation. The author of each section updates his information by using the background program LIBRARYIN.

ROOTSTOCK is a reference program which determines the optimum rootstock for an apple orchard given the planned specifications of the orchard. The user specifies the soil type, desired spacing, and fruiting variety planned and receives a recommendation of the optimum rootstock.

Both reference programs were developed as the result of suggestions from SCAMP users.

## C. Documentation

If a system is to continue to operate for a long time, its workings must be documented. When new users come into a system, there must be a means to instruct them in the use of the system. When a new programmer comes to an established computer system, he should not have to discover its workings by trial and error.

Documentation of the SCAMP system serves three functions. First, it provides instructions on the use of programs for the general user. Second, it provides instructions to the central staff to carry out the various operations necessary. Third, it details the structure of all programs for the programming staff and provides standards for new programs to insure continuity.

This documentation is in three manuals: Users, Operations, and System manuals.

### 1. User Documentation

User documentation takes the form of a User's Manual (6) which contains detailed explanation of each general use program on SCAMP. This manual is given to each SCAMP user and is intended to supplement the instructions given by the programs.

### 2. Operations Documentation

The SCAMP staff performs certain regular tasks which keep the system running smoothly. These tasks are background operations and do not concern the general user. They include: making telephone connections for users, entering miscellaneous data, logging messages, adding users to the authorization list, assigning accounts,

transferring weather data, and running several background programs. All these operations are fully described in an Operations Manual.

## 3. Systems Documentation

Systems Documentation is the description of the internal structure of all SCAMP programs and of the relationships between them. It also includes the standards for writing new programs. Systems documentation is essential to the programming staff for the maintenance of existing programs and the writing of new ones. Our standards for program documentation are described in a paper by Russo, Sarette, and Barnard (7).

## D. Training

The implementation of SCAMP provided extension and research personnel a type of information system which was totally new to most of them. In the first two years of implementation, faculty and extension agents attended a one-day training school at Geneva which provided hands-on experience with SCAMP. Individual training sessions were also provided at the county level for secretaries. In many counties where the number of agents using SCAMP began to increase, secretaries were often assigned the responsibility of interacting with SCAMP.

In 1980 and 1981, regional SCAMP training schools were held in five different locations throughout the state. These half-day schools were attended by agents, secretaries, and Cornell faculty. One of the underlying principles in developing SCAMP was to refrain from making extensive changes in user operation. This has provided continuity from year to year and made the introduction of new programs fairly easy to comprehend.

## PERSPECTIVE

SCAMP is an information delivery system which has served portions of the agricultural community in New York since 1978. It began as a communications system for Integrated Pest Management on tree fruit.

After a successful first year, SCAMP began to broaden its services to include other groups. The alfalfa pest management group began to use SCAMP in 1979 and was joined by vegetable IPM workers. At the same time other agricultural extension workers, along with growers and industry fieldmen, began to use SCAMP. With the addition of these groups and as the numbers involved from each group grew, the number of SCAMP users reached 167 by the end of 1980.

Concurrently with this growth in the number of users, the services and amount of information available were increasing at the same rate. The number of programs available has grown from 4, when SCAMP began, to 16 in March of 1981.

A SCAMP user can now communicate with any other user, report field observations, send news items (summaries of field observations and other relevant information), peruse field observations from observers over the en-

tire state, receive specialists' interpretations of current problems, receive pest management strategies, weather forecasts, and chemical labels, and get the output of three different simulation models of pest activity.

The overall pattern of SCAMP usage closely follows the pattern of agricultural activity. The largest use of SCAMP occurs from May to August, and begins to drop after harvest in September. Extension faculty and agents concerned with greenhouse operations use SCAMP through the winter months. Program usage too follows a stable pattern. The electronic mail programs are the most used followed by the weather programs. The remaining programs, taken as a group, are used about half as much as the electronic mail programs. This is understandable, since the data collection, models, and reference programs cater to the needs of sub-groups of users.

In 1978 and 1979 most of the new programs were added to SCAMP. 1980 was viewed as a year for consolidation of services. Existing programs were enhanced and all SCAMP programs were documented. An additional accomplishment in 1980 was the acquisition of weather data from the NOAA weather wire. With this data we were able to implement fully two simulation models which we had acquired in 1979, WEEVIL, (an alfalfa weevil simulator), and PETE, (which modeled the development of several insects).

## A. PROBLEMS

The primary function of the SCAMP system has been to provide a channel for communication between agricultural extension workers, and to supplement these communications with information from other sources, (e.g. weather information and model predictions).

For a communication system to work efficiently there must be a two-way flow of information. There is a tendency for some users to look on the system as a place to receive information that is useful to them, (e.g. reports of migrating pests,) without using it to disseminate information which may be of value to others.

One of the needs that is expressed by SCAMP users is for more interpretive programs, (e.g. what do the counts from the insect traps mean?) We have addressed this by implementing predictive models and by encouraging extension specialists to send interpretations of current problems over NEWS. On this system we have a classic dichotomy. University personnel who helped design the system need more raw data from the field, while field workers (extension personnel) have raw data that needs interpretation by the university workers.

## B. FUTURE DEVELOPMENTS

We feel that the framework of SCAMP now is broad enough to serve all types of extension applications. In the near future, new commodity groups will be added to the communication programs, and current programs will be expanded. More types of weather information will be made

available, (e.g. radar weather, national, and state-wide summaries). We also expect to see programs in nutrition, dairy-herd management, and pesticide information on SCAMP. A system such as SCAMP could easily become the standard Extension Information System for the Northeast. A copy of SCAMP is already operating in New Hampshire, and we will transfer it to other states as well.

The recent report of the Cornell Extension Committee for Utilization of Computer Technology (8) calls for networking of all extension and Cornell facilities for computer-assisted communications and information transfer. We feel SCAMP is quite adaptable to this plan.

Longer range development plans call for investigations into rapid data exchanges between extension field programs and the central site through SCAMP, exploration of modified versions of SCAMP operating at the extension office level, and adaption of certain SCAMP programs for use in on-the-farm computers.

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## Appendix One—Scamp Programs

### I. General Use Programs

NYMAIN	Scamp operating system, NYMAIN retrieves messages, accepts program selection, and keeps a log of each session.
MESSAGE	Used to send information from user to user or from user to the programs NEWS, FIELD, or STRATEGY.
FORECAST	Displays NOAA weather forecasts for the 16 forecast zones in NY.
INDEX BLITECAST	Displays list of general use programs. Pennsylvania State University's model for potato late blight, provides spray recommendations.
FIELD	Displays report of field observations in last seven days.

NEWS	Displays summaries and interpretations of field observations made in the last seven days.
STRATEGY	Displays pest management strategies for current pest problems.
NAMES	Displays list of all current users by commodity-group.
DEGREEDAY	Calculates growing degree-days for current season at selected weather stations.
DDGENE	Calculates growing degree-days for any year since 1900 at Geneva.
SUGGEST	Transmits user suggestions to SCAMP staff.
WEEVILMAP	Displays map of Alfalfa Weevil development for five alfalfa pest management zones in NY.
LIBRARY	Displays pest management information for several subjects: pest control, pest description, phenological information, pesticide labels, and pest management practices.
SCABSTATUS	Displays data on progress of Applescab disease in NY.
ROOTSTOCK	Recommends optimum apple rootstock given soil type, spacing, and variety planned for an orchard.
WEATHERDATA	Displays data from selected weather station.

## II. Restricted or Background Programs

SPRAY	Accepts spray records from the tree fruit IPM program and summarizes them.
TRAP	Accepts pheromone trap catch data and summarizes them.
Weather Input	A family of programs which take raw data from the NOAA weather wire and reformat it for use on SCAMP.
HARVEST	Accepts end of season tree fruit inspection records and summarizes them.
DLMO	Gives SCAMP staff access to background programs and data.
ACCTS	Summarizes SCAMP use by account for each month.
INFO	Gives SCAMP users access to their private data bases.
PESTSTATUS	Displays the output of the PETE insect phenology model.
PETE	Generalized insect phenology model, predicts the phenological stage of several insects from temperature data.
WEEVIL	Predicts the phenological stage of the alfalfa weevil from temperature data. Its output is used to generate the Weevilmap.
WEEVILIN	Enables the alfalfa pest management staff to run the weevil model and to update the weevilmaps.
LIBRARYIN	Allows Library author to update their sections of Library.

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Table 1.—Scamp software—general use programs.

Program	Year			
	78	79	80	81
NYMAIN	X	X	X	X
MESSAGE	X	X	X	X
FORECAST	X	X	X	X
INDEX	X	X	X	X
BLITECAST		X	X	X
FIELD		X	X	X
NEWS		X	X	X
STRATEGY		X	X	X
NAMES		X	X	X
DEGREEDAY		X	X	X
DDGENE		X	X	X
SUGGEST		X	X	X
WEEVILMAP		X	X	X
LIBRARY			X	X
SCABSTATUS			X	X
ROOTSTOCK				X
WEATHERDATA				X

Table 2.—Scamp software—restricted or background programs.

Program	Year			
	78	79	80	81
SPRAY	X	X	X	X
TRAP	X	X		
Weather Input	X	X	X	X
HARVEST	X	X	X	X
DLMO		X	X	X
ACCTS		X	X	X
INPUTER		X	X	
INFO			X	X
PESTSTATUS			X	X
PETE			X	X
WEEVIL			X	X
WEEVILIN				X
LIBRARYIN				X

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