

A Simple and Inexpensive System for Collection of Data at Remote Locations

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ABSTRACT

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A program for data collection called RATE was developed for use on lightweight, inexpensive pocket computers. Using RATE, form files are constructed on a personal computer (PC), then downloaded to a pocket computer. Identifiers are displayed on the screen, and data are recorded using the keypad. The program is flexible and allows the user to edit and review recorded data anytime during data collection. Stored data can be printed with an accessory program called PRINT and/or uploaded to a PC or mainframe computer, when convenient, in a format suitable for immediate data analysis. The RATE program used in conjunction with a pocket computer allows rapid, accurate collection of data with easily portable and inexpensive equipment.

Collection of data at remote locations is common in plant pathology and other agricultural disciplines. Greenhouse, field, and laboratory experiments involve collection of qualitative and quantitative data for individual plants or plots. Such variables as disease incidence and severity, insect damage, and stage of plant development may be considered. This process usually involves recording many numbers and comments on paper, often in a format generated by or for a computer (2). Later the data are entered into computer files. This conventional method of handling data is time-consuming and requires data to be recorded twice, offering opportunity for errors during transcription. Alternative electronic methods have included recording data on tape, which requires later transcription, or using laptop computers, which usually requires a desk or equivalent surface.

Hand-held units are available for recording data generated by various instruments and later transferring files to a personal computer (PC). Some of these units have keyboards that allow manual entry of data. The units designed and marketed specifically for remote entry of scientific data generally have comparatively bulky entry units and may cost several thousand dollars.

At least three manufacturers—Casio (Dover, NJ), Sharp Corp. (Osaka, Japan), and Psion, PLC (London, England)—market lightweight, hand-held computers. These “pocket”

computers were developed primarily as business organizers, but they can be utilized for data entry because they have the capacity to exchange files with a PC. A pocket computer with the cables and software necessary to link to a PC can be purchased for less than \$500 (Table 1). Pocket computers, unlike larger ones, do not have associated software designed specifically for entry of scientific data. These computers, however, are easily programmed. Casio and Sharp computers are programmed in BASIC, and Psion computers are programmed in a BASIC-like language called Organiser

Programming Language. The necessity to program the computer offers the opportunity to customize the program to the specific needs of the user.

These computers can be used in a system for data management that greatly

Table 1. Approximate costs of some Casio and Psion components usable in data entry systems

Component	Cost (\$)
Hand-held computers	
Casio FX-850P	165
Casio PB-1000	230
Psion Organiser II-XP	250
Psion Organiser II-LZ	300
Psion Organiser II-LZ64	400
Interface units (RS232)	
Casio FA-6	130
Casio FA-7	140
Psion Comms-Link	100
Removable memory packs	
Casio RP-8 8K Ram Pack	20
Casio RP-32 32K Ram Pack	50
Casio RP-33 32K Ram Pack	50
Psion 32K Datapak	60
Psion 64K Datapak	100
Psion 128K Datapak	200
Psion 32K Ram Pak	100



Fig. 1. (A) The compact Organiser II-XP has a two-line display and an alphanumeric keypad. (B) Two slots on the back of the Organiser accept Datapaks and Ram Paks for permanent storage of data.

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reduces handling time and errors involved in the collection and transfer of data (3). The system that we use allows entry of many types of data and storage of data on removable memory packs. Recorded data can be inspected by viewing the computer display or by printing files with a battery-powered portable printer. Data are uploaded to an IBM or IBM-compatible PC via an RS232 interface cable, eliminating the necessity of manually entering data into computer files. In addition, a modem can be used to transfer data files via a telephone. With minimal editing, the uploaded PC files may be prepared for analysis of data by statistical programs (2) or the files can be transferred to a mainframe computer and processed by programs such as those of SAS (1).

We obtained specifications for the pocket computers offered by Casio and Psion. The units offered by these manufacturers seemed equivalent in most respects. Casio had the advantage of a larger display and a standard keyboard arrangement, and Psion had the advantage of larger memory capacity.

The available pocket computers use different operating systems. Thus, programs and procedures for data entry must be tailored for the computer used. The basic processes of data entry, storage, and retrieval are similar, however, and a system developed for one computer should be adaptable for another.

The remainder of this paper describes the procedures and programs we devel-

oped to utilize the Psion Organiser for remote entry of data. We call the data acquisition program RATE and an accessory program PRINT.

System components

The RATE program is written in Organiser Programming Language. The program is compatible with all models of the Organiser and controls the entry and storage of data. The Organiser is hand-held, has a complete alphanumeric keypad (Fig. 1A), and weighs 210 g. The LCD display has adjustable backlighting that makes characters clearly visible under varying light conditions, including full sunlight. The various models of the Organiser differ mainly in the amount of available internal memory and in availability of a two-line or four-line display. They are powered by a 9-V battery or by an AC adaptor.

Datapaks (Psion, PLC) for permanent storage of data fit into slots on the back of all Organiser models (Fig. 1B) and function similarly to a disk drive. Memory sizes of individual Datapaks vary from 8K to 128K; those with 32K or greater memory are most useful and convenient. The memory of Datapaks may be erased with ultraviolet light, using any standard EPROM (erasable programmable read only memory) eraser, and sized for reuse. Ram Paks (Psion, PLC), available in several sizes, can replace Datapaks and save data with greater speed and efficiency. Ram Paks are erased and formatted by the Organiser and do not require exposure to ultraviolet light for erasure.

The Comms-Link (Psion, PLC) package is used to transfer data and programs from a PC to the Organiser, or vice versa. The package consists of an RS232 interface cable and supporting software that can be used with any IBM-compatible PC.

The accessory program PRINT allows data files to be printed by any of several battery-powered portable printers, including Radio Shack TRP 100 and models sold by Psion PLC.

The basic system utilizes the Organiser II-XP, two 32K Datapaks, and the Comms-Link package, at a total cost of approximately \$470. Datapaks with

larger memory sizes and other models of the Organiser help tailor the system to fit the needs of the user.

Procedures

The first step in use of RATE is the creation of a form file (Fig. 2). The file contains an identifier for each plot or sample (up to four characters); corresponding descriptors, such as cultivar names (up to 12 characters); and asterisks as field separators. A form file is easily constructed on a PC using any text editor. A file can also be created quickly by editing an existing file that contains the identifiers and descriptors. Such files are often created by software designed for randomization or plot design. The file can be constructed without descriptors if "blind" ratings are required. Comms-Link is used to download form files from a PC to the Organiser for storage in a Datapak.

At this point, the Organiser is ready for use independent of other devices. RATE is used to record up to three data entries for each identifier; the first two entries are numeric, and the third may be numeric or alphabetic. Names of each variable can be displayed on the screen before data are recorded. Functions available by pressing certain keys (Table 2) allow the user: 1) to view and edit data entries by scrolling through the file or by searching for a particular identifier, 2) to update data entries by saving to a Datapak, and 3) to exit the program with an option to save data entries.

After entries have been recorded on the Organiser and saved to Datapaks, the data files can be inspected and edited on the Organiser. Files can be edited in any order and as often as necessary. Files uploaded to a PC contain identifiers, descriptors, and recorded data (Fig. 3).

Flexibility of RATE

The use of RATE requires only elementary knowledge of the operation of the Organiser. The program is designed for easy use and provides on-screen guidance, including prompts and error messages. The program is flexible; with an operations manual and some

```
0001*HOLLEY      *
0002*FLORIDA 302 *
0003*CONTROL     *
0004*SALUDA      *
0005*HUNTER      *
0006*COKER 983  *
```

Fig. 2. A sample form file generated by a personal computer for use by RATE to record disease severity data associated with wheat cultivars. On the first line, 0001 is the identifier (plot number), Holley is the descriptor (cultivar name), and asterisks are field separators.

Table 2. Functions available for the RATE program

Key	Function
D	Display directory of specified device
E	Edit currently displayed data entry
G	Display specified identifier
Q	Exit program with option to save
S	Save data entries without exiting program
	Scroll through data entries of currently displayed identifier
→	Display next identifier
←	Display previous identifier

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0001*HOLLEY      50  25
0002*FLORIDA 302  0   0   INSECT DAMAGE
0003*CONTROL     12  0
0004*SALUDA      56  5   HEAVY RUST
0005*HUNTER      1   1
0006*COKER 983  10  1
```

Fig. 3. A sample file with data for two variables and comments that was generated by RATE and transferred from the Organiser to a personal computer. On the first line, 0001 is the identifier (plot number), Holley is the descriptor (cultivar name), 50 is the data entry for variable 1, and 25 is the data entry for variable 2; the fourth data column is available for comments.

knowledge of programming, the program can be changed to suit individual needs. Minor revisions may allow the user to record more than three entries for each identifier, to change the format of data entry, and to enter alphabetic and/or numeric data.

We have used RATE with the Psion Organiser during the past 3 years for the collection of many types of data in the laboratory, greenhouse, and field. The system substantially reduces the amount of time spent handling data, making it possible to analyze data just minutes after collection. Recording data requires

just as much time as recording the same data on paper, but the task of manually transcribing data into computer files and the risk of transcription errors are eliminated.

Small computers other than those mentioned probably also could be used in a similar data-handling system. Any hand-held computer that can exchange files with a PC, has at least 16K of memory, and can be programmed to handle the data is suitable.

RATE, PRINT, and detailed instructions may be obtained by sending a blank, formatted 5.25-in. (13.3-cm)

floppy diskette, along with a self-addressed mailer, to the second author.

LITERATURE CITED

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Salute to APS Sustaining Associates

This section is designed to help APS members understand more about APS Sustaining Associates. Information was supplied by company representatives. Each month different companies will be featured. A complete listing appears in each issue of *Phytopathology*.

Twyford International Inc. Contact: Robert Hartman, 11850 Twitty Rd., Sebring, FL 33870; 813/655-3700 (formerly Hartman's Plants Inc.).

Uniroyal Chemical Company. Contact: Allyn R. Bell, 74 Amity Rd., Bethany, CT 06410; 203/393-2163. Uniroyal established an agricultural chemical company over 45 years ago as a developer and supplier of fungicides, herbicides, miticides, and plant growth regulants. Emphasis was directed toward providing unique products in each of these areas. With the introduction of systemic fungicides for cereal/cotton disease control, the company began a solid commitment to seed treatment technology worldwide. Gustafson, Inc., an associate, has strengthened its efforts in this technology. Uniroyal also markets several soil fungicides for row crops, turf, and ornamentals. Its current spectrum of fungicide products consists of carboxin (Vitavax), etridiazole (Terrazole), oxy-carboxin (Plantvax), PCNB (Terraclor), and Thiram. Efforts are directed at foliar fungicides for fruit and field crops, including both systemic and nonsystemic active ingredients. The company has active programs with various universities, USDA pathologists, and extension people in the United States to evaluate these candidates in disease management programs.

Unocal Chemicals. Contact: Sahag K. Garabedian, 3960 Industrial Blvd., Suite 600B, West Sacramento, CA 95691; 916/372-6050.

W-L Research, Inc. Contact: Michael Peterson, Director of Research, 8701 Hwy. 14, Evansville, WI 53536; 608/882-4100. W-L Research is the oldest company in the United States devoted exclusively to developing improved alfalfa varieties.

The company operates nationwide and has become a major supplier of seed to the proprietary alfalfa market. W-L Research performs intensive selection for genetic resistance to several major alfalfa diseases, including bacterial wilt, Fusarium wilt, Verticillium wilt, Phytophthora root rot, and anthracnose. Future plans include selection for resistance to important foliar diseases, including common leaf spot, spring black stem, and Lepto leaf spot. W-L Research has a serious commitment to improving disease resistance in alfalfa and intends to pass these benefits onto farmers throughout the world.

Agriculture Canada. Contact: Librarian, Research Station, Vineland Station, Ontario, Canada L0R 2E0; 416/562-4113. The Agriculture Canada Vineland Research Station, one of more than 40 research establishments of the Research Branch of Agriculture Canada, was built in 1967 and was formed from amalgamating the Dominion Entomological Laboratory at Vineland and the Plant Pathology Laboratory in St. Catharines. A comprehensive program of crop protection research serving the horticultural industry is carried out at the Vineland Research Station. A multidisciplinary approach is administered with application of entomology, toxicology, acarology, nematology, virology, mycology, computing science, and residue chemistry expertise to the pest and disease problems of various horticultural crops. Pest and disease management programs at the station include research on tree fruits, vegetables, grapes, glasshouse ornamentals, small fruits, and woody ornamentals. Some work is also performed on forage crops and tobacco. The diversification of plant protection research supports a wide range of horticultural industry problems.

Agri-Diagnostics Associates. Contact: Steve Banegas, Moorestown West Corporate Center, 1 Executive Drive, Suite 10, Moorestown, NJ 08057; 609/727-4858. Agri-Diagnostics is dedicated to improving the management of agronomic practices through diagnostic products that provide reliable, rapid, and economical detection of plant pathogens, chemicals, and plant components.

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