Punched Cards as Aids in Evaluating Seedlings in the Field*

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All systems devised to assist in taking and analyzing field notes for evaluating seedlings of fruits have some disadvantages, but some have marked advantages. Circling or underlining printed descriptions and ratings on a 3 × 5 inch card is perhaps the simplest and easiest method of recording detailed field notes on seedling populations. The cards are of convenient size for handling and storing. After the notes have been taken, however, the painstaking and sometimes prohibitive task of analyzing the data begins. Machine analysis is the logical solution. One can hand-transfer all the information from field cards to punched cards or tapes; but this involves an extra step and the accompanying chance for error.

Some of the advantages and disadvantages of three types of punched cards adapted to field use will be discussed here. The number of char-
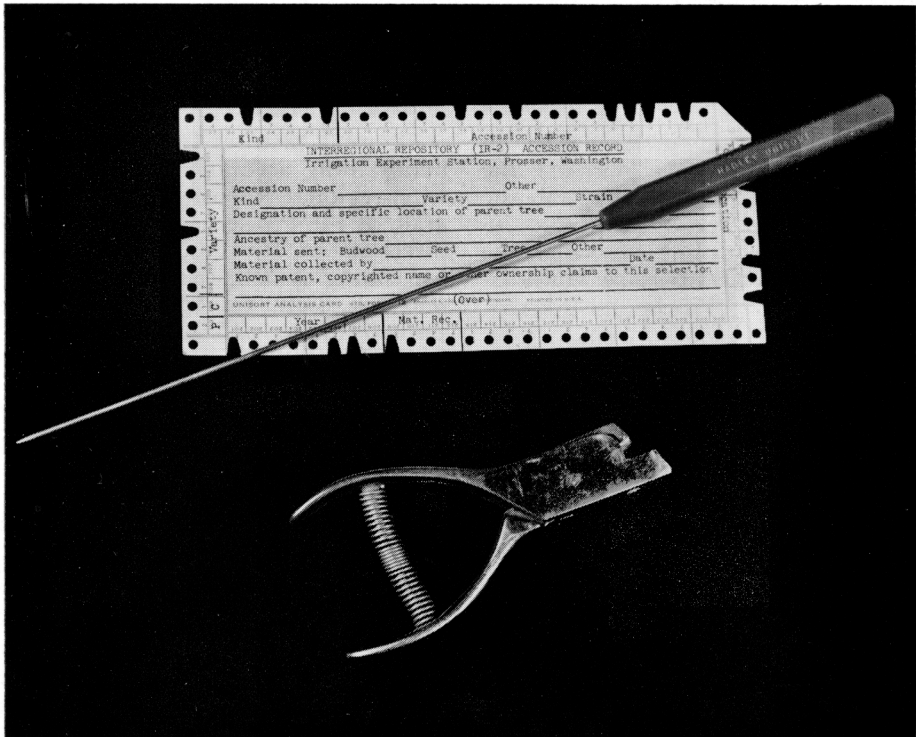

Fig. 1. Typical edge-notched punch card and accessories used in the Inter-regional Repository Program in Washington state.

Fig. 2. Overprinted mark-sense card used in evaluating peach seedlings in the stone fruit breeding program at Prosser, Washington.

acteristics to be rated, the extent to which the data will be analyzed, the convenience of the card size, and the adaptability of the card to the intended field handling and machine sorting, are all important considerations in selecting the proper card.

Edge-Notched Cards

The simplest punched cards have punches along the outside edges. Appropriate punches are notched to record the specific ratings for an individual. Cards are sorted by inserting needles at one or more specific punches for the population in ques- tion. All cards bearing the information being sought will drop away from the needles. After the cards are counted they are returned to the stack.

Cards used vary from about 3 × 5 inch cards with less than 60 punches, up to about 3¼ × 7½ inch ones with 72 to 114 punches. Larger cards are available but are not adaptable for field use.

Figure 1 pictures the card used in maintaining accession records in the Inter-regional Repository (IR–2) pro- gram at the Prosser station under the direction of Dr. Paul Fridlund. In his coding system, the notches repre- sent accession, for example, of the Earliril apricot as budwood from the Irrigation Experiment Station varie- ty plantings. For the amount of in- formation represented here, this card has proven very satisfactory. Coding saves several spaces in that, singly or in combination, all the values from 1 through 10 can be notched out from the numbers 1, 2, 4, and 7 and any number up to 100 can be made with two sets of these 4 numbers. Code numbers represent species, variety lo- cation and other data.

This type of card is not suitable, however, for seedlings being rated 1 to 10 for several characteristics or treatments for several variables. If a number of positive or negative or similar alternative evaluations are

involved, these cards might be adequate.

Sorting by hand is time consuming if very many characteristics are involved. It is possible, of course, to transfer the data to cards for machine sorting, but this involves an extra step, hand punching.

Mark-sensing Cards

The mark-sensing system permits the use of the same card for taking field notes and for machine analysis. Figure 2 shows the card used for evaluating peach seedlings at this station. One-third of the columns on a standard $3\frac{1}{4} \times 7\frac{3}{8}$ inch card are utilized. To record a specific note on an individual, the appropriate space is marked by a heavy graphite pencil line within the designated brackets. The pencil mark must be continuous and heavy enough to transmit an electrical impulse. Machines are designed to translate this mark to an equivalent punch on the field card or another card, either of which can then be machine sorted.

The mark-sense card has the distinct advantage over the edge-punched cards of having 27 different 0 to 9 rating columns. The card can be overprinted with appropriate column headings and descriptive designations for any particular space. In practice, it seems wise to use 0 spaces as zeros or as no data spaces, as is most appropriate. This leaves the 1 to 9 spaces for ratings. A slight adjustment from the usual 1 to 10 rating
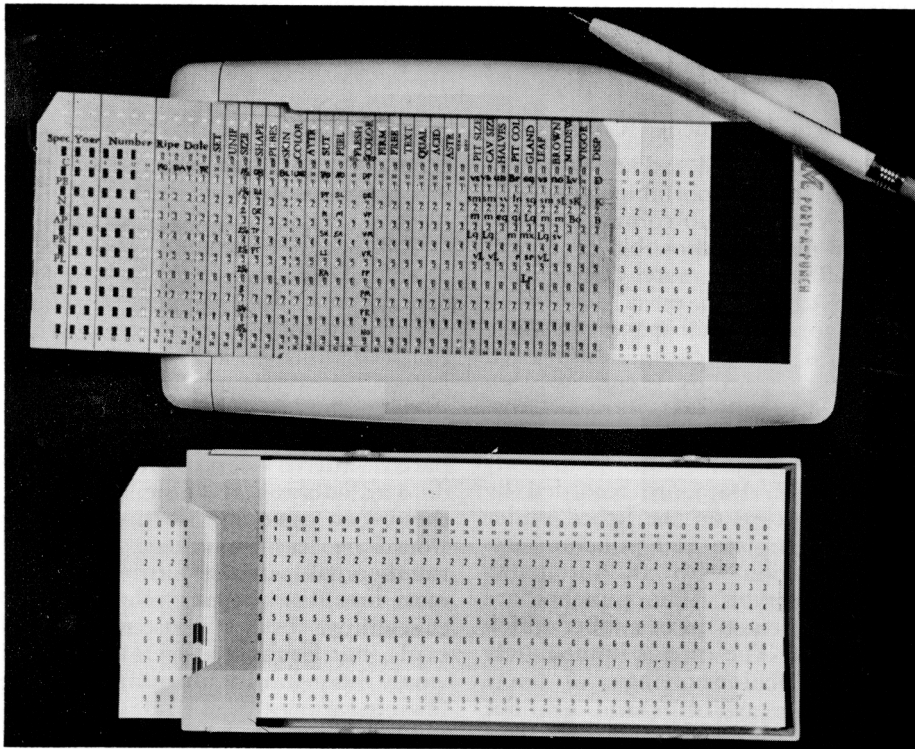

Fig. 3. Portable punch card accessories and master card for stone fruit seedling evaluation in the breeding program at Prosser, Washington.

system may be required, although, in most cases, the use of the ninth space to represent both 9 and 10 is sufficient. Where measurements are possible, discrete designations can be given to successive spaces in the column.

Maintaining sequence is not necessary because the machine can sort out cards having the same cross or treatment designations. Notes can be taken on seedlings as the fruit is tree-ripe, and the card for that individual need not be taken to the field again. A method of marking discards and tagging selections is necessary, of course, to prevent duplication of evaluations.

A disadvantage of the system is that more time is consumed in making the continuous necessary pencil lines than in underlining or circling appropriate comments on the 3 × 5 inch card previously used. Care must also be exercised to prevent bending and tearing the cards.

Portable Punched Cards

Some additional advantages are inherent in the portable punching system. A total of 40 columns of 0 to 9 spaces makes it possible to record about 50 percent more information on each card than on a mark-sense card. Two additional spaces are available at the head of each column. Each space of the card is pre-stamped so that it can be punched out easily. The punching board is roughly 9 × 5⅛ inches overall and is held easily in one hand. Data are recorded by placing the card on the board under a plastic template and punching appropriate holes with an automatic-pencil-type stylus. The punches are forced between strips of rubber which retain them. The card is immediately ready for machine sorting.

The cards are thin and are not adapted to numerous handlings and sortings. When repeated handlings are necessary, a standard card can be machine-duplicated from the field card. A card carrier which attaches to the punch board adds only about ½ inch to the thickness of the board and aids in keeping the cards undamaged. It holds 50 cards.

The individual cards can be overprinted with appropriate headings or the headings can be printed on the template and blank cards used. In practice we attach a fully punched card printed with the desired headings, underneath the template. This protects the printing from direct wear and yet the headings are easily seen through the template. Figure 3 illustrates the equipment and the headings used for evaluating peach, nectarine, apricot and plum seedlings here. A slightly different master card is used for sweet cherry evaluations.

The time required to push through a punch is less than that for any of the other punched card systems and about the same as that for circling or underlining a printed 3 × 5 card. The punch is positive, whereas a few of the mark-sense lines will fail to transmit an impulse. The increased information possible on the card may be an important advantage.

Machine sorting is the primary advantage of the last two systems. Whether simple frequency distributions or multiple regression analyses are to be calculated from the cards, these are easily accomplished by machine sorting in a few hours, as compared with days or months required on a calculating machine. Neither of these two machine sorting systems would be feasible unless substantial numbers of cards are involved. For more complex analyses, relatively fewer seedlings justify the use of punched cards, but probably several thousand would be a minimum number where few characteristics are rated and simple analyses are performed. In our stone fruit seedling evaluations, we believe that 700 to 800 cards fully justify the use of the machine system.