RECORDING IN POULTRY IMPROVEMENT

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FEATURES OF POULTRY BREEDING

The poultry industry has changed rapidly from a traditional small farm operation to a factory-type agrobusiness in the last 2-3 decades, using highly efficient, competitive, and sometimes vertically integrated, production systems. During this period, a large number of poultry breeders left the industry, and at present only half a dozen firms provide most of the poultry breeding stock in Australia. As these firms all employ qualified geneticists, reasonably efficient recording systems have already been implemented and a high degree of performance recording achieved in poultry breeding programs. New improved systems are likely to be adopted quickly in the future as they become available.

In contrast to the larger animal industries, the small individual value and high fecundity of poultry, together with the size of breeding organizations, make it possible for individual breeders to maintain quite large breeding flocks. So, coordinated recording systems on a regional or national basis and performance recording at central testing stations need not be considered. The high degree of environmental control, rapid reproduction and discrete (non-overlapping) generations reduce the need for adjustment of raw data to a minimum; in most cases, hatch effect remains the only major factor requiring adjustment. Most characters used up till now can be measured easily and objectively except for some related to broiler quality; and pedigree recording is relatively easy with single-bird cages and artificial insemination, or single-sire breeding pens with trap-nesting, together with pedigree identification during incubation and wing-banding on hatching.

A recording system may be evaluated in terms of accuracy, efficiency and cost of data collection, availability of data, speed of processing, stability of the system, and ease and reliability of data storage.

PRESENT SITUATION

Although there is considerable variation in recording systems between broiler and layer breeding programs, and among different breeding firms, the general pattern seems to be a combination of manual recording with paper and pencil, and electronic data processing. This involves all or some of the following steps: preparation of recording sheets, manual recording, abstraction of data using desk-top calculators, transfer of data to punch cards or other media suitable for electronic processing, collating and sorting data, editing, data adjustment, temporary storage, data analysis and archiving.

1. Efficiency and Cost

The current data recording systems are variable in efficiency depending on the detailed procedures and situations, and difficult to evaluate properly without closer examination of each system. Hence, their efficiency will be exemplified with the costs of data estimated for the CSIRO Poultry Unit recording system, which appears not much different from those being used in commercial poultry breeding programs (Table 1). The costs have been

calculated in terms of man-minutes expended per layer pullet at housing in measuring, recording and preparing a datum for electronic data processing. These estimates are based on individual 5-day per week daily egg production recording to 300 days of age for part-annual and to 455 days of age for annual production, mortality of 10% during rearing and another 10% after housing at 16-18 weeks of age, 4-5 eggs for egg weight and quality characters at given ages, and body weights at the same ages, in a flock of 500-600 pullets at housing produced from about 120 dams.

TABLE 1: Labour costs of layer records estimated for the CSIRO recording system (man-minutes per pullet housed with percentage in parentheses)

Records	Part-Annual Recording	Annual Recording
Pedigree	7.9 (25.9)	7.9 (16.1)
Egg production and sexual maturity	13.7 (45.2)	25.1 (51.4)
Body weight	0.9 (2.8)	1.7 (3.4)
Egg weight and quality	6.0 (19.8)	12.0 (24.6)
Mortality	1.0 (3.4)	1.3 (2.7)
Dam's reproduction	0.9 (2.9)	0.9 (1.8)
Total	30.4 (100.0)	48.9 (100.0)
Weights of all eggs (manual weighing, direct punching on paper tape)	40.3	68.4
Weekly feed intake from 20-65 weeks	21.7	40.9
Monthly body weight from 20-65 weeks	5.9	10.8

It is clear from Table 1 that egg production is the most expensive character to record, followed by egg weight and quality and pedigree information, in a layer breeding program. Hence, efforts should be concentrated on reducing the cost of egg production data if one wishes to improve the efficiency of the system. Table 1 also gives costs of some special data, which might be interesting to those who would attempt to change the egg weight-age relationship or to improve feed efficiency of layers by measuring individual feed intake. Although these data appear to be expensive to collect, a lot of saving on some of these estimates is in fact possible by judiciously choosing the frequency of measurements, e.g. Podger and Sheldon's (1978) study on the sampling frequency of egg weight records. Sheldon, Podger and Morris (1969) recorded individual pullet's time of lay for a test period of 28 days, which was the basis of selection for reduced oviposition interval; the cost of data recording including the extra expenses on special data logging facilities and computer software was not excessive, being about the same as the total for part-annual recording in Table 1.

The costs of data presented in Table 1 account for only those activities that can be easily enumerated, and so other operational costs and capital investments have to be taken into consideration for complete costing. The computing cost of data processing, analysis and storage is variable, depending on specific requirements, but generally inexpensive relative to the major items in Table 1 (an equivalent of 2-4 man-minutes per pullet housed in the CSIRO system).

The value of a certain record relative to its cost is very much dependent on how the record is utilized and how widely the genetic improvement accrued can be disseminated through the industry. So a general answer may not be given to the question of optimum level of expenditure on recording. For instance, feed intake of individual birds has been regarded as being too expensive to measure relative to the additional genetic gain in feed efficiency above that derived from selection on egg production only. However, only a specific cost-benefit analysis will indicate whether expenditure of say 2500 man-hours on feed intake measurement in a flock of 500 pullets over 10 generations should pay off in the future.

2. Accuracy

The rate of recording errors is difficult to estimate and rarely reported. Although current recording systems have cross-checking steps embedded and various editing processes included, some human errors inevitably occur. Our experience shows that the rate of pedigree errors 'detectable during data analysis' has been about 1 in 2000-3000, but this could be very much an underestimate as the proportion of suspect pedigrees revealed by blood typing was estimated at 0.70% (McGibbon *et al*, 1978). 'Detectable' errors in other types of records seem to occur at a similar rate in our recording system.

Egg production is usually recorded on 3-5 days a week and this should give a reasonably accurate estimate of total egg number, the correlation with 7-day recording being 0.96-0.98 (Faber, 1960). Specific gravity, albumen quality (Haugh unit) and egg weight at a given age are quite repeatable, with the repeatability of single measurements being 0.47, 0.73 and 0.83 (Yoo, unpublished data), and the average of 3-5 eggs per pullet should be adequate. At present, feed intake of individual birds is not recorded in commercial breeding flocks, although a reasonably accurate estimate of total feed intake may be obtained from the record of feed intake in every sixth week with a correlation of 0.95 (Yoo, Podger and Sheldon, unpublished data).

3. Availability and Other Factors

As most of the present commercial recording systems rely on paper and pencil until the accumulated data are prepared for electronic processing, records in progress are usually not available for intermediate analyses. In addition, original records for some characters are abstracted manually and only the summary data are prepared for further processing. This means that the original records are not normally accessible in the system and a lag of 2-4 weeks is inevitable between finishing collection of records and data analysis. However, once the data are entered into a computing system, they can be retrieved and analysed very quickly. It should be noted that the life-time egg weight records and time of oviposition data mentioned above are encoded directly on punch paper tapes and thus may be processed immediately.

Collected records are still stored mostly in paper and computer card forms, but computer-based archiving systems using random-access discs and magnetic tapes are increasingly in use. This trend will alleviate the data

storage space and accessibility problems in the future. It may be noted that in poultry breeding programs, the number of records is rather large, though the storage period of a record may be relatively short, compared to records of larger animals.

The current recording systems have been generally stable and consistent over a number of years. In fact, over-conservatism and cautiousness in this matter appear to slow down adoption of new data handling methods in some commercial breeding organizations. A balance is needed between stability and innovation in any recording system.

4. Broilers

Recording in broiler breeding programs in Australia is usually limited to pedigree, body weight at 6-8 weeks of age, body conformation, hatchability and mortality. Egg weight and production (or number of saleable chickens per dam) are rarely recorded. Hence, except for body conformation, the recording procedures are generally simpler than, and for these characters, similar to those in layer breeding programs. It may be noted that in some breeding flocks, selection on body weight is carried out at weighing according to an approximate truncation point pre-determined from weights of a small sample of birds and no individual records are kept, thus keeping recording costs to a minimum.

EXISTING PROBLEMS

The major deficiencies emanating from the preceding section may be summarized as follows: The efficiency of recording particularly for repeated observations like egg production or egg weight needs to be improved to cut the cost of data. Records in progress should be available for intermediate analyses to increase the flexibility of a breeding operation. Original data, rather than their summary, should be handled in the computing system to increase the availability of data and to reduce the tedious and time-consuming process of data abstraction. Lastly, more computer-based data storage facilities have to be used to improve retrieval and statistical analyses of past data.

CURRENT AND POTENTIAL DEVELOPMENTS

To improve the efficiency and accuracy of recording, the number of steps in the data collection and handling system should be reduced. The hand-held data-entry terminals, which have been developed recently for retail sales systems, may be used with minor changes for this purpose. For instance, a recording system based on this type of terminal is now in use to encode daily egg production records at a speed of 100 cages per minute with apparently high accuracy (Dr A.K. Sheridan, personal communication). This is about 5 times faster than the manual recording considered in Table 1. Subsequently, the records are dumped on punch paper tapes which may be taken directly to a main-frame computer for further data processing. In addition to speed and apparent accuracy, this system increases availability of data considerably and makes various aspects of egg production amenable to detailed analyses. Further, the hand-held data-entry terminal may be interfaced with measuring devices, like an electronic balance, to record other characters automatically. Hence, implementation of a recording system using this kind of hand-held data-entry terminal in combination with a Teletype or a mini-computer with appropriate peripherals, may be recommended, provided that the system is

carefully designed to keep the error rate low and tested thoroughly for reliability and accuracy.

Data storage is becoming a serious problem, as modern breeding programs demand not only the summary of current generation data for selection, but also statistical analyses of accumulated data to improve the efficiency of selection and to evaluate the progress of the breeding program. This requires a reliable, easily accessible, low cost data base, and so more use will be made of random-access discs and magnetic tapes with concomitant development of data base management systems suitable for poultry performance records.

The expenditure on data recording and associated activities is a sizable proportion of the total cost of a breeding program. So recording practices should be under constant review to prune superfluous records, but not to omit relevant records. In the future, an operations research approach may be required to decide the kind and quantity of information that are both sufficient to evaluate a genotype accurately and justifiable in terms of the extra genetic gain expected (Lerner and Donald, 1966). Further, this approach will allow each step of recording procedures to be closely examined to pinpoint the steps which are either prone to errors or inefficient.

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