EVALUATION OF BREED RESOURCES AND THEIR UTILIZATION IN POULTRY

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As both Abplanalp (1986) and Fairfull and Gowe (1986) have pointed out, the concept of breed in modern poultry industry has been almost eliminated and the breeding stocks we concern no longer descend from purebred parents. Also strong selection directed at a few traits of economic importance changed the physical requirements for the breed. Instead of using the name of the breed, commercial breeders today use White Leghorn type or White Cornish type birds since late 1950's. This is a distinctive characteristic of poultry compared with other livestock.

A quite thorough survey of literatures for heterosis in economic merits in $F_1$, 3-way and 4-way crosses was made by Fairfull and Gowe (1986), in addition to their own experiments conducted in Ottawa for more than 10 years. Their conclusions were: (1) egg production and related traits have a large epistatic effect, (2) sex-linkage is more important than maternal effect but the latter is important for early growth and viability, (3) expectations of performance from pures were correlated with 2-way, 3-way and $F_2$ cross means for age of sexual maturity and body weight, and (4) expectations from 2-way were correlated with 3-way and $F_2$ for egg production, age of sexual maturity and body weight but predictions of 4-way were rather poor. Our own unpublished data of 4-way crosses, predicted by multiple regressions based on pures, 2-way and 3-way showed the highest yet moderate correlations with pures but 2-way and 3-way were rather poor predictors as were observed by Fairfull and Gowe. For meat type birds, the differentiation of specialized sire and dam lines is a common practice in the industry, where dam lines are being selected for egg production and egg size with some attention to egg shell quality, while male lines are almost exclusively selected for early growth, meatiness and vigor. Our knowledge on the cross performance in meat type birds is very limited.

Abplanalp took a different perspective on the genetic resources of chickens. Commercial poultry bred for egg or meat production is virtually under the control of a few large breeding organizations which do not publicize the details of information on the origin of the bird, breeding history and performance testing. On the contrary, many lines and mutations of poultry that have originated in the course of scientific research are being maintained elsewhere at research stations and universities throughout the world. These stocks are invaluable genetic resources capable of establishing and preserving essential continuity of genetic diversity for research. In particular, the need for a high degree of genetic control associated with experiments on immune responses and disease resistance, has led to the development of congenic lines, which are potentially useful for the preservation and analysis of complex genetic systems. The usefulness of these congenic lines in poultry research and development depends on their reproduction and fitness.

Mukherjee, Shoffner and Yamada (1986) surveyed literatures on turkeys, ducks and geese for the past few decades and concluded that development potentials in those species have not been fully exploited in comparison with chickens although high yielding meat producing turkey and duck strains are available as the outcome of artificial selection. Information on crossbreedings in those species is so scanty that any conclusion of the relationship between purebreds and crossbreds performance cannot be commented. Mukherjee et al emphasized the
importance of genotype by environment interactions in ducks, because breeding organizations in the West would continue to dominate duckling market in Asia, where a wide variety of managerial and rearing systems in South, Southeast and East Asia may require creation of new genotypes that are different from genotypes adapted to European breeding objectives. The importance of ducks in Asia is to utilize the wasted natural resources more efficiently by using them for scavengers in dry fallow fields or catching fish in ponds, canals and rivers and herding on newly harvested rice field. Systematic duck breeding in the region must be encouraged to establish new genetic resources adapted to their local conditions.

Apart from preservation of genetic resources in poultry, we must have a certain measure to evaluate these breeds or strains of poultry as (1) potential breeding stocks, (2) parental lines for crossing for immediate use, and (3) potential parents for intermediate future use. Such rankings involve definition of 'value' in terms of relative emphasis on different components of performance and consumers' preference. A general criterion for breed evaluation is the potential reduction in cost per unit of animal product value, which depends largely upon efficiency of three functions, i.e., reproduction, female's production and growth of the young (Dickerson, 1974). One definition of net efficiency is the ratio of total costs to total animal product value from females and their progeny over a given period of time (e.g., formula 1 in Dickerson, 1970).

Costs and product values can be measured with varying degrees of sophistication. Requirement for breed evaluation in any species is the relative economic weight of unit genetic change in each performance component, which is comparable to those required for constructing a linear selection index (Hazel, 1943). Such information must be obtained from cost analyses in the production systems but is subjected to inaccuracy in its nature, because market systems and locality are always confounded with pricing systems. Jakubec, Podebradsky, Pichova and Hyanek (1974) presented quite complicated selection indices in which so many characteristics of pure and hybrids are included to rank pure broiler lines and their crosses, according to profit. However, usefulness of such complicated models would be very limited in practice.

As an alternative to such sophisticated but rather ambiguous approaches, a concept of the breeding goal, which is the predetermined levels of traits of our concern in each strain, can be introduced. This is direct application of the selection index which aims to attain the predetermined breeding goal with the minimum number of generations. This selection index presented by Yamada, Yokouchi and Nishida (1975) is unique as a solution of normal equations to obtain appropriate weights to the component traits of the index which is derived with the condition that the breeding goal is attained with the minimum number of generations. Exactly the same selection index could be obtained by Kempthorne and Nordskog (1959), Harville (1977) and Tallis (1985) by setting very special constraints (Itoh and Yamada, 1986).

Suppose we want to select the best male and female strains from several potential breeding stocks. Our breeding goals for male and female parental lines are $Q' = [\text{feed requirement (FR)} = 2.38, \text{age of sexual maturity (SM)} = 150d, \text{body weight (BW)} = 1.6kg, \text{hen-housed egg production (HDEP)} = 80\%, \text{egg weight (EW)} = 60g, \text{adult viability (AV)} = 90\%]$ for males and the corresponding goal in females is $Q'' = [\text{2.4, 160d, 1.8kg, 78\%, 64g, 90\%}]$. For each candidate strain, we calculate the difference between the goal and the mean of the strain for each component trait. Suppose further that the selection index we calculate is made up of SM, BW, HDEP up to 280d and EW, i.e., $I = b_1 \text{(SM)} + b_2 \text{(BW)} + b_3 \text{(HDEP 280)} + b_4 \text{(EW)}$. 

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For each strain appropriate selection index is obtained with the minimum generation numbers to achieve the predetermined goal. This enables us to rank all strains in terms of generation numbers, namely distance. Then, we choose the best male and female strains which are located in the shortest distance to the respective goals. The desired levels of all traits incorporated into the breeding goal will be accomplished simultaneously by adopting the index, at least in theory. To evaluate those strains for crossbred's performance, the goal has to be adjusted for heterosis.

REFERENCES


