FLOCK FACTORS AFFECTING THE EFFICIENCY OF GENETIC IMPROVEMENT IN POULTRY

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INTRODUCTION

Within line genetic improvement in a character per unit time is determined by three factors, viz. (i) the heritability of the trait; (ii) the selection differential; and (iii) the generation interval. Whilst it is always desirable to maximise heritability, the selection differential is determined by the proportion of animals mated and if set too high, will result in a significant increase in the level of inbreeding. Within the limits of adequate reproduction and accurate measurement of the trait in question, it is always desirable to minimise the generation interval. The commercial poultry breeder however, has a number of traits to consider within each of his various lines and he must carefully balance the emphasis placed upon the different traits to yield optimum economic response in both the short and long term.

There are a number of flock factors relating to the design of breeding programs which affect the efficiency of genetic information in both the broiler and egg industries. Among such factors are flock size and culling levels.

Flock Size

A compromise must be struck between the number of flocks held and the effective population size of the flocks. Although flock size does not have major effects upon short term response, it would appear that on average, long term response increases with increasing population size.

Culling Levels

Apart from the main selected traits, there are certain traits which are genetically controlled and which may be undesirable, e.g. leg defects and feather colour. In some cases there are degrees of effect and a decision must be made as to where to set the culling level.

BROILER INDUSTRY

The classical picture here is male birds, from a line selected largely for growth rate and conformation, are mated to females obtained from a cross between two female lines, each also selected largely for growth rate and conformation to produce the commercial progeny. Selection is practised both at the nucleus level and to varying extents in the grandparent and parent generations. Whilst there is a high positive genetic relationship between growth and conformation, the relationship between reproductive performance and these traits is decidedly negative. To date, the maintenance of reasonable reproductive

performance in broiler breeding stock has been achieved largely through environmental and manipulation, notably control of food intake during both the rearing and laying periods.

There are a number of flock factors affecting genetic improvement in broilers and which are related to environmental influences which result in the loss of birds or in increased environmental variation causing a depression in heritability.

(a) Day old to point of selection

(i) Early chick mortality. Numerous causal factors must be minimised so that selection differential is not unduly depressed.

(ii) Leg weakness. If recognised, means elimination of birds from selection. If sub-clinical invariably means depressed performance. Depresses both heritability and selection differential. Genetic, nutritional and possibly disease involvement.

(iii) Test environment. Important that test environment both physical and nutritional broadly reflects the normal broiler growing environment (G x E interaction) and that environmental variation is minimal (i.e. heritability is maximised).

(b) Selection to Mating

(i) Rearing programs. Following weighing at selection, broilers are normally reared under restricted feeding in order to improve subsequent reproductive performance. The general effects of such practice are to increase hatchable egg production and fertility and reduce adult mortality. One effect is to delay the onset of sexual maturity. A compromise must therefore be struck between the beneficial effects in increasing the selection differential and the delay in sexual maturity which lengthens the generation interval.

(ii) Acute disease losses, e.g. Mareks and leukosis. Involvement of early and post-selection vaccination programs.

(iii) Leg weakness. Renders birds unsuitable for natural mating and undesirable in any case since the weakness will be propagated in the next generation. In some lines this may have a large effect upon the selection differential.

(iv) Identification losses. As above.

EGG INDUSTRY

Here the commercial bird is produced from a mating between a male from one breed to females of another breed or strain. Selection is practised in most cases at the nucleus level only. Initial selection is for egg production to about 44 weeks of age, egg weight, body weight and shell quality, with lesser emphasis on other traits, e.g. albumen quality, defects, M.D. susceptibility, etc. Information from individual and family performance is used. Final selections are made prior to housing when data for the residual period of production (44-68 weeks) is available. Males are selected on the performance of their sisters.

Apart from the design factors listed earlier, similar to broilers, the main flock factors affecting genetic improvement are those relating to environmental influences which either result in the loss of birds or increase environmental variation and reduce heritability.

(a) Day old to point of lay

(i) Factors causing losses. Since selection does not commence until point of lay, provided losses are not excessive, additional chicks can be reared so the number starting on test is not affected. Genetic predisposition to conditions resulting in rearing mortality can be taken into account in selection.

(ii) Factors depressing performance. Any factor causing depressed performance during rearing may influence subsequent laying performance and as such, cause a depression in heritability and selection differential.

(b) Point of lay to selection

(i) Sub-clinical infection. One of the most important environmental factors affecting genetic improvement in layer birds is sub-clinical leukosis. Egg production in affected birds is depressed to varying degrees. The disease is widespread and can have a high morbidity rate. Birds may be selected largely because they have not contracted the disease rather than because of any genetic superiority. Family averages can be very considerably affected by the proportion of birds with sub-clinical leukosis.

(ii) Part period selection. In an endeavour to reduce generation interval, most commercial breeders have selected their birds for part period egg production. Whilst moderate to high correlations between part record and residual egg production are frequently reported in the literature, Frazer (1981) suggested that response in full year egg number is very close to zero in most flocks and attributed this largely to selection of female parents with relatively poor residual period performance.

(iii) Acute losses, e.g. Mareks, leukosis - can be quite high and will depress selection differential.

(c) Selection to mating

(i) Further losses. The time period between selection and mating is short which usually means that losses here are relatively of minor importance.

(ii) Reproductive performance. The effects of a depression in reproductive performance which can be caused by a large number of factors are basically of two types, viz. (i) complete loss of genetic material from particular mating combinations and (ii) reduced production of progeny. In the former case potentially superior genetic material can be lost altogether and in the latter there may be requirement for more hatches to produce the required number of progeny, thus providing additional environmental variation with its resultant effect upon the heritability.

REFERENCES

FRAZER, R.A. (1981). *Proc. 2nd Conf. Aust. Assoc. Anim. Breeding and Genetics*. 149-152.