Selecting layer genetics according to field conditions

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In a world where the population is growing at the rate of 220,000 people per day, the demand for animal protein is constantly increasing. Eggs are a relatively cheap protein source with a high nutritional value and they are already in their 'final packaging', which makes the global egg market (mainly 'local for local') grow at a steady pace of 2-3% per year.

Thanks to these facts, global egg production is now at a level of some 63.5 million metric tons per year and about half of this output is destined for Asia. The average egg consumption has reached a level of about 10kg per capita, whereas it was only 6kg in the early 1990s.

Distribution of the world's egg production is following the growth of the population and the growth of egg consumption per capita. As an example, Asia represented about 55% of the total egg production in 2010. We have observed local production for local consumption. Indeed, export is really limited (2%) when we compare it to the export of broiler meat (17%).

Alternative production systems

In several countries consumption has already been high for many years. In those countries market segmentation through the development of alternative production systems, together with the development of the egg industry (eggs in liquid or powder form), supported the total egg consumption.

In parallel with population growth, the price of resources (raw materials) is becoming more expensive. Therefore good feed efficiency of laying hens is also an important asset for the development of production.

In order to be able to produce commercial layers which perform well in various production conditions and to continue to transfer the genetic progress expected by the egg industry generation after generation, the geneticist has to take into account these evolutions in the breeding program and he has to secure the fact that the final ranking determining the final choice to reproduce the next generation is well balanced.

To achieve this goal and to respond to market requirements in term of egg quality, productivity, feed efficiency and liveability, different ways or selection programs are possible.

The environment of the traditional layer breeding program to improve the genetic potential of the commercial stocks was usually to place the pure lines in individual cages in a fully controlled environment. Various selection environments relating to feed presentation, feed specifications, or feed compositions already existed.

Pure line stocks and commercial stocks (four way cross) do not perform the same in different environments. The interest in using the combination of pure line performances and commercial cross performances is probably of first importance and a general practice now of the major egg layer breeding companies.

The other factor is the selection environment, but each commercial farm has its own specific environment. The introduction of too many environments or too many uncontrolled factors could lead to an ineffective selection program.

Nevertheless, some of them could be introduced into the breeding program. Some of them could be applied directly in the pure line farm, in optimal conditions, without reducing the ability of the breeding companies to deliver genetic material under optimal and biosecurity conditions.

The housing system is one of the environmental factors. Various housing systems exist – open or closed house systems, cage systems (individual cages, collective cages, or enriched cages) or alternative systems of production. Pure lines or commercial cross, which are performing well on floor systems, usually perform well in cage systems.

The reverse may not be so evident. The combination of records from both systems allows the adaptability of the commercial stocks to be secured and allows the breeding companies to introduce behaviour criteria in the selection index.

Country variations

Feed characteristics can vary a lot from one country to another according to the raw materials available and the technology used to produce this feed. Raw material used, feed presentation, energy levels and frequent feed changes can greatly influence the performance of the birds. Cross line tests in commercial farms could allows these various types of feed to be included into the breeding program.

Egg production is a real local production and climatic conditions are totally different between, for example, an environmentally controlled layer farm in North America and an open house farm in Indonesia. This variation in environments also has to be integrated in the selection schemes of the layer breeding companies.

To explain our breeding goals, we usually speak about egg quality, productivity, efficiency, and liveability. Behind that there is a multitude of criteria for each of them. Some of them are much more sensitive to the effects of the environment or the combination of environments.

In addition, the layer genetic companies also have to adapt their breeding program to the evolution of the market environment. Competition is becoming more important and economical efficiency even more critical. Adaptation to the market requirements is a priority, including egg quality, egg size distribution, longevity and persistency, etc.

In addition to the traditional BLUP selection, genomics is now available to speed up genetic progress and also to introduce some environmental factors.

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In genetics, it is important to get back to basics from time to time and to come back regularly with the same question to re-evaluate it. It is an eternal challenge but progress is always possible.

For many years, the philosophy of some breeding companies was to produce layer breeds selected in one specific environment expecting that technical adjustments will compensate for the natural lack of adaptation to the local environment.

The combination of genotype information and genotype and environment interaction remains important. Birds have to be selected under the particular conditions in which we want them to perform best.

Today, it is not only the genetic potential in a specific environment, but also the ability of the layers breeds to perform well in the various conditions of production.

The Utopige project

In order to develop a breeding program according to field conditions, Novogen has developed, in collaboration with INRA, a specific genomic study taking into account pure line and crossbred performances in various production conditions.

This Utopige project aims at elaborating realistic strategies for the implementation of genomic selection in breeding schemes which use crossbreeding through a pyramid structure with selection in pure breeds and production by crossbred animals.

The ultimate objective is to improve the breeding scheme efficiency by increasing the accuracy of breeding values considering the opportunity offered by high density genotyping provided by the recently released SNP Chips.

A total of 500 males from a specific line have been used as a resource population for the estimation of SNP effects on traits in pure breeds and crossbreeds. All these sires have been collected for blood for DNA extraction.

Firstly, males have been evaluated from pure breed information. The performances used for this genetic evaluation will concern the full sisters of these males, with a total of 5,000 hens controlled. Phenotypic data such as egg number, egg size, egg quality, bodyweight, behaviour in colony cage, mortality and reasons for mortality are collected.

Secondly, the same males have been progeny tested through crossbred lines (A*CD).

Furthermore, progenies are split into two groups of around 40 progenies. Those two groups are fed with extreme levels of energy existing in the production environment, one with a high energy level, as in North America (2,900Kcal), the other one with a low energy level, as in India (2,400Kcal).

Phenotypic data such as egg number, egg size, body weight, egg quality, mortality and reasons for mortality are collected. For each sire, two genetic evaluations are computed according to the environment. The last phase will be dedicated to the validation of genomic selection.

Six hundred young males of the line A born in one hatching group will be collected for blood for DNA extraction at 10 weeks of age. Two Genomic Estimated Breeding Values (GEBV) may be estimated for each male, one in the high energy environment and one in the low energy environment.

Among the 600 young males, the 10 best and 10 worst males for each environment will be selected at 30 weeks of age (40 males selected) considering the global objective of selection of the A line.

Each of these males will be progeny tested in crossbreed as before on 40 progenies per farm (1600 layers per farm, i.e. 3,200 layers controlled) to estimate the response to selection.

This project, started in 2011, will help Novogen to gain a better knowledge of genomic information and the influence of specific genes in different environments. One of the main objectives is to detect specific genes for adaptability to different kinds of environments.

The relation between genomic and phenotypic data collected in this project will be very useful in the future to speed up the genetic progress in both males and females, and for various conditions of production. ■