Continued leadership in genetic innovations for the **21st Century**

by the technical R&D team, Hy-Line International.

oultry breeding is a combination of acquired expertise and science that requires long term investments of both time and resources. Each elite line that is used at a grandparent level contains a large number of birds that are extensively measured for multiple traits throughout their lifetime.

The best individuals are identified and used to breed the next generation. Those subsequent generations are then used to make the hybrid crosses that ultimately result in the commercial layer.

Research program

In their research program, Hy-Line carefully measures over 30 different traits of importance to commercial egg production and bird welfare. Among others, these traits include liveability, egg production, feed efficiency, nesting behaviour, persistency of lay, and interior and exterior egg quality traits.

In addition, Hy-Line has the industry's largest and most comprehensive field test program with sire-coded progeny placed in

Fig. 1. Hyline's research program.



commercial operations in several locations around the world.

This program gives real-world results from test birds producing in different climates with a variety of management systems, feeds, feeding programs and disease challenges. The results facilitate family selections and provide essential data for the selection process. Information from hundreds of thousands of birds in both the research and

> field test programs is fed into massive databases for statistical analysis.

As geneticists evaluate each bird against others in that generation, the expertise of genetic selection emerges. Advanced statistical procedures analyse thousands of data points collected from each research bird to predict that bird's breeding values for all traits.

Then using their expertise in poultry breeding, the genetics team decides the relative emphasis of each trait and generates a selection index to make the final decision to select which birds progress to the next generation.

Years of selection in the elite lines determines the commercial layer's ultimate performance in the field. Hy-Line continues to

breed birds with excellent egg production, as well as leading the industry in the traits of liveabiilty, feed efficiency and egg quality by placing long term emphasis on these characteristics.

Chicken breeding today happens the same way as designed by Mother Nature – semen from roosters fertilising hens. The eggs laid by those hens are then incubated and hatched as chicks. The selection process involves identification of the best birds from the best families with the best performance and selecting those birds to produce the next generation of elite breeding stock.

The new tools

The Hy-Line Molecular Genetics Program strives to identify the many small variations in the DNA of each elite bird that have an impact on the important traits being studied.

When the program was initiated in 1996, the state-of-the-art technology allowed study of 100 different DNA variations (or markers).

Bird-to-bird variation was identified in 5,000 samples per week and correlated to performance characteristics. DNA samples from every selected bird from every Hy-Line generation since 1996 have been maintained creating the world's most extensive DNA archive in the poultry industry.

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Scientists from Hy-Line and the EW Group have recently collaborated with UK scientists and sequenced the DNA of Hy-Line's elite pedigree lines. This research identified over 39 million novel changes that exist within the DNA code of chickens.

The changes in the DNA (single nucleotide polymorphisms or SNPs) are quick and easy to detect due to the development of the next level of molecular genetic testing – a SNP 'chip' that analyses 650,000 SNPs from one bird simultaneously! Even more impressive is the fact that 96 of these 'chips' are mounted on a single plate to allow detection of over 62 million SNPs at the same time!



Over 62 million SNPs can be simultaneously analysed with this plate.

Moving into 2013, the Hy-Line molecular genetics laboratory has been upgraded to generate SNP information. A recent investment in a KBioscience SNP Line System (valued over \$450,000) allows for rapid in-house detection of SNP variations. This system allows individual testing of thousands of samples for hundreds of carefully selected SNPs at a rate of over 100,000 tests per day.

Combining information from both the

650,000 SNP 'chip' and this in-house SNP detection system provides the best and most rapid identification of genetic variations important for commercial egg production.

The volumes and complexity of data generated by these new technologies is unimaginable. A dedicated software system is used to analyse the SNP data and integrates those results into the existing databases that contain the thousands of data points on performance traits gathered on the research farms and from global field tests. Utilising newly developed statistical methods, these technologies are now used to compare SNP variations to performance. Finally assembled, all of this information predicts breeding values used for selection – a process known as genomic selection.

Both the speed and accuracy of the selection process is improved with genomic selection. Not only will the right birds be selected, but their genetic potential is identified earlier in the bird's life. Hy-Line's real-world testing confirms that the annual rate of improvement will increase I 5-40% year-onyear, depending on the specific trait being measured!

The learning

Geneticists have long observed great genetic diversity within lines, even in closed populations, based on their work using traditional research techniques. Use of these new advanced molecular tools has uncovered the existence of considerable genetic diversity that will sustain elite breeding lines long into the future.

Hy-Line geneticists have worked in collaboration with university and government researchers in studying many challenges relevant to the breeding of poultry. These col-

Hy-Line geneticists (from left to right) Dr Jesus Arango, statistical geneticist, Dr Neil O'Sullivan, director of research, Dr Petek Settar, population geneticist and Dr Janet Fulton, molecular geneticist. Not pictured – Dr Ania Wolc, genomic geneticist.



laborative efforts have yielded a wide range of scientific papers published for the advancement and understanding of breeding and genetics in poultry and other species.

The bottom line

Hy-Line's Research Program will continue to select for layer varieties that are productive, as well as also address the important concerns of animal welfare, environmental impact of commercial egg production, and serve as an important source of human nutrition.

A breeding company combines information from multiple traits to develop a breeding program emphasising different aspects of the egg production process.

Besides egg production, Hy-Line has always been focused on liveability, feed efficiency and egg quality resulting in birds producing

the most egg mass for the least cost. These important characteristics have an even more broad-reaching impact. Superior liveability of Hy-Line varieties assures all of us concerned about animal welfare that the birds are healthy throughout their productive life.

Superior feed efficiency reduces the amount of arable land use for grain production. Less feed used by Hy-Line layers lowers the emission of greenhouse gases and reduces the carbon footprint of egg production resulting in a more sustainable industry.

And finally, superior egg shell quality means a higher percentage of eggs reach the consumer. This well balanced research program is accomplished with the expertise of selection using traditional methods now enhanced by including genomic selection in Hy-Line's unique and pioneering genetics program.

Genetic innovations

As the oldest layer genetics company, Hy-Line International owns a long list of innovative firsts – beginning with hybrid vigour from crossing multiple elite (pure) lines to produce hybrid layers in the 1930s, the use of blood-types as a genetic marker for liveability in the 1960s and the first major breeder to introduce feather-sexing of day-old chicks with the W-36 in the 1970s. So it is not surprising that Hy-Line was the first poultry breeding company to establish an in-house molecular genetics program in 1996 and to complete a stateof-the-art laboratory in 1997. In collaboration with university scientists, Hy-Line was the first layer breeding company to privately fund and subsequently implement genomic selection on a commercial scale.