

Layer breeding in the light of future requirements

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The world population passed the mark of 7 billion last year and continues to increase at a rate of about 80 million people per year; the demand for eggs is increasing at least at the same rate. The global production of eggs, estimated at 65 million tons in 2005, is predicted to increase to about 75 million tons by 2015, i.e. by 1 million tons annually within the current 10-year period. To satisfy the increasing demand, at least 50 million hens have to be added each year, assuming management conditions to support the genetic potential for 20 kg egg mass per hen.

Current per capita egg consumption and the rate of change differ considerably between continents and countries within continents, depending on traditions, purchasing power and the availability of other sources of food. Europe and North America has little growth potential, while the demand in China, India, Latin America and selected countries in Africa is expected to grow considerably, especially due to changing consumer habits of educated urban people with the necessary purchasing power.

Consumer habits and preferences for specific egg characteristics like shell colour and egg size also differ between countries and between consumers within a country. Japan, for example, has maintained one of the highest levels of consumption with more than 300 eggs per capita for decades. The custom of breaking a raw egg over a bowl of rice for breakfast helps to explain the focus on egg quality: white-shelled eggs with superior internal egg quality and guaranteed freedom from Salmonella. White eggs are also preferred in North and Central America, the Middle East, India, Taiwan and the Philippines, whereas brown eggs are preferred in most of Latin America and Europe. Tinted eggs, produced from crosses between White Leghorns and brown-egg breeds, are popular in Japan and China, but seldom seen in Europe.

The layer breeding industry has gone through significant changes during the past decades and has a remarkable record to cope with new challenges. Increased egg production, improved feed efficiency and adaptation of egg quality to consumer preferences have contributed significantly to the success of the poultry industry. Without these genetic improvements and corresponding improvement of nutrition, disease control and general farm management, the poultry industry would not have achieved its current position in the global food market. While the focus has to remain on maximizing the genetic potential for producing high quality protein at competitive cost, additional requirements of the egg industry, changing consumer habits and public opinion have to be taken into account.

Primary breeders have to look beyond current requirements and anticipate changing needs and opportunities at least five years into the future. Close communication between breeders and distributors is necessary to introduce new varieties at the right time to benefit from growing niche markets. For the global layer business, diverse markets have to be served and each of these may prefer different performance profiles of the commercial layers. This requires extensive gene pools with large elite lines which can be combined to generate strain crosses with specific attributes to meet market needs as closely as possible. Maintaining and developing new lines, testing, selection and reproduction of primary stocks involves high fixed costs in the operation and requires superior skills in quantitative genetics as well as internal organization to keep track of the availability of different sub-lines for niche markets. Genetic development, marketing and technical support have to communicate closely with local distributors to provide the best possible service for the current market and to benefit from changing requirements.

Housing systems vary between continents and within Europe. In Switzerland, Austria, Sweden and Germany, commercial layer cages have been banned for several years. Enriched cages, considered by poultry scientists as an acceptable compromise between demands of animal welfare organizations and the "needs" of laying hens, are currently being installed in many countries as an alterna-

tive to conventional battery cages. In Germany, however, major discounters have stopped selling eggs from "Kleingruppenhaltung", and animal welfare groups continue to lobby for a complete ban on cages in Germany. In other countries, enriched cages are only used to produce table eggs for export to Germany and for the egg processing industry.

To supply the best possible combination for each market with specified optimal egg weight and most common housing system, Lohmann Tierzucht offers five different strain crosses, which are all selected with focus on efficient egg production, but with different emphasis on individual selection traits.

For line improvement, pure-line and cross-line hens are being tested in different environments: in single, small group and family cages as well as under floor conditions with a new kind of "trap-nesting". To comply with German poultry welfare regulations, all cages had to be enriched with perches, nests and scratching areas. Daily egg production is recorded with the aid of barcode readers, various egg quality traits (mainly egg weight, shell stability and shell colour) and plumage condition are recorded on a sample basis across the production cycle. Individual feed intake and daily egg mass are determined at peak production, i.e. during the time of maximum performance, so that selection for improved efficiency reflects the capacity for sufficient feed intake at a time of greatest nutrient demand.

Testing under floor conditions with trap-nesting to measure individual egg production and egg quality was practiced in the breeding program of Lohmann Tierzucht until about 1970, but was replaced by more efficient single cage and group cage testing. Almost ten years ago, testing individual performance in floor systems has been resumed, using a specially adapted transponder technique and the Weihenstephan Funnel Nest Box to obtain individual information on egg production, nest acceptance and utilization of outdoor facilities (winter garden or free-range). The data are used in family selection for "number of saleable nest eggs", penalizing families with poor nest acceptance which tend to produce floor eggs. The moderate heritability of "nest eggs" recorded in these floor systems suggests that further progress can be made. However, egg producers should not expect miracles from genetic selection and must pay proper attention to rearing conditions, a timely transfer to the production house and optimal nest arrangement to minimise the number of displaced eggs. Critical are also an adequate lighting regime adjusted feed formulation and feeding.

For the foreseeable future, we can safely assume that general breeding goals such as egg number, feed efficiency and egg quality traits will remain priorities. Behaviour patterns and especially behaviour anomalies are likely to get more attention outside the Western world. Suitability for floor housing and free-range systems has become more important, and this includes attention to a whole range of traits: acceptance of nests and free-range, persistent plumage cover to the end of lay, resistance to common diseases and minimal tendency to develop feather-pecking or cannibalism. National laws and regulations will reflect continuing attempts to define priorities and "sustainability" in terms of adequate nutrition for the growing human population, protection of the environment and natural resources, ethical standards for animal farming, and – last but not least – economics.

Lohmann Tierzucht will continue to invest in additional testing capacities which reflect typical field conditions in different markets. At the same time, the genetic basis of the elite lines will be expanded to accommodate the demand of growing markets, which in turn will minimise the rate of inbreeding and the risk of losing valuable genetic variation. A special program to match selected males and females at the pedigree level assures that inbreeding effects are minimized and genetic progress continues at a predictable rate.

Advances in molecular biology have contributed new techniques for selection. Using informative genetic markers, geneticists can identify individuals and families with special characteristics early in life and thereby accelerate improvements in egg production, egg quality, behaviour and liveability. These innovations complement traditional performance testing and evaluation methods based on phenotypic selection indexes of production, efficiency and quality parameters.

Combining all available performance records from relatives in several generations, locations and housing systems requires powerful computer programs, but assures that the best males and females are selected and mated to generate the next generation. Additional information based on DNA analysis is combined with traditional breeding to select males at an earlier age and to differentiate among full brothers, which used to have identical breeding values before DNA information became available. The combination of performance testing as described above and genome wide analysis is a promising tool for developing new strain crosses with a performance profile tailored to specific requirements.

The current rate of genetic progress for total efficiency of egg production appears to be even greater than it was 20 years ago. An improved structure and increased size of breeding populations, the application of new testing and recording technologies and more powerful computer systems for breeding value estimation have contributed to more efficient use of existing genetic variation. The application of new technologies will play an even greater role in improving the rate of genetic progress for layers used in conventional and none-cage environments.

Finally, we should realize that increased genetic potential needs to be "translated" into reality in commercial practice. Disease control, farm management and nutrition have to keep pace with genetic improvements, and more efficient production is no guarantee for farm income in case the markets are oversupplied.

Zusammenfassung

Legehennenzucht für den künftigen Weltmarkt unter Bedingungen deutscher Tierschutzauflagen

Der rasch wachsende Weltmarkt für Eier und Eiprodukte verlangt eine breitere Palette von Linienkombinationen mit einem an die jeweiligen Märkte angepassten Leistungsprofil. Kostengünstige Produktion von Eiern mit marktgerechter Eiqualität bleibt das Hauptziel der genetischen Entwicklungsarbeit, wobei neue Techniken der Datenerfassung und Zuchtwertschätzung weitere genetische Fortschritte erwarten lassen. Die zunehmende Belastung der Legehennenzucht in Deutschland durch strengere Auflagen des Tierschutzes wird durch erweiterte Testkapazität mit konventioneller Haltung in Ländern außerhalb der EU und Umstellung auf EU-konforme Haltung in Deutschland beantwortet.

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