

Animals in Intensive Production Systems



POULTRY – BREEDER INDUSTRY

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INTENDED LEARNING OUTCOMES

At the end of this lecture, you should be able to describe:

- The poultry production systems
- The scientific principles of growth, reproduction, and breeding
- The management of poultry production systems

KEYWORDS

Brooding, rearing, production, poultry breeders

LECTURE OVERVIEW

Chicken breeds/strains

Domestic chickens (*Gallus gallus domesticus*) are descended from the red jungle fowl. Over time intensive genetic selection has enabled the development of specific lines of birds that are reared for meat and egg production. Boilers are reared for meat production while egg laying hens are reared to lay eggs for human consumption.

Broilers

Broiler breeders and their progeny evolved from crosses of the White Plymouth Rock hen crossed with the White Cornish male. In Europe the light Sussex and in the US the New Hampshire breeds were also used. These crosses have evolved to become the modern white commercial broiler, which are in favour today.

The major broiler primary producers are Aviagen and Cobb-Vantress. Their two major commercial broiler lines are Ross and Cobb respectively. Both these lines are grown in Australia, with Ross being the predominant broiler strain grown.

Egg layers

White lines, which produce a white egg, have evolved from the single comb white leghorn.

Brown egg lines, which are brown in colour and produce a brown egg have evolved from crosses of Rhode Island Red and White.

Brown eggs are preferred by the consumer in Australia so brown egg layers predominate the market. The major commercial egg production breeds used in Australia are the ISA brown, Hy-Line brown, Hisex (now not sold) and Lohmann (newly arrived). Seventy percent of the egg producers are supplied by Hy-Line.

There are now only a small number of major commercial poultry breeding company's worldwide supplying grandparent and parent poultry stock for the layer and broiler industries. The major primary breeding companies have been slowly acquired until only a few remain. Most have maintained their original lines, but it is feared that many lines will be combined and eventually disappear.

Primary Breeding Company	Species	Production Type	Brand
Aviagen	Chicken	Meat	Ross Abor Acre Indian River
	Turkey	Meat	Nicholas B.U.T
Cobb-Vantress	Chicken	Meat	Cobb
Hendrix	Chicken	Layer	ISA Babcock Shaver Hisex Bovans Dekalb
	Turkey	Meat	Hybrid
Hy-Line International	Chicken	Layer	Hy-Line
Lohmann	Chicken	Layer	Lohmann
Groupe Grimaud	Duck	Dual	Grimaud Frères Sélection
	Chicken	Meat	Hubbard
		Layer	Novogen
Cherry Valley	Duck	Dual	Cherry Valley

Genetic selection and breeding

Traditional breeding programs are based on selective breeding of pedigree lines of birds – Elite birds comprising multiple lines of male and female lines, called great grandparent and grandparent lines. These lines are successively crossed to produce commercial progeny.

Genetic selection objectives

Selection of elite birds requires a balance between selection for growth or reproductive characteristics. Some of the phenotypic traits (size, egg size, growth rate) are only partially influenced by the genetic profile while the environment determines much more. Environmental influencers include temperature, incubation, feed.

Heritability (H), which is a measure of the difference between genetic variation and the observed variation, is an indicator of the ability of a particular trait to be inherited by successive generations. Growth traits are easily selected, as the heritability is relatively high (0.4-0.6). Reproductive traits have much lower heritability (0.05-0.20) and so selection for these traits are much slower and harder. Selection for growth characteristics hinders selection for reproductive traits.

The key selection criteria for commercial poultry breeding are:

- Production output per bird
- Efficiency per unit of feed intake
- Increased resistance to disease/behaviour traits
- Body conformation
- Liveability (survival)

In meat producing birds (broilers/turkeys/ducks) the indices for improvement are:

- Increased growth rate (shorter time to maturity)
- Increased feed conversion efficiency

In egg producing birds (egg layers/breeders) the indices used for improvement are:

- Increased egg production (number)
- Increased efficiency of conversion of feed per egg produced
- Increased fertility, hatchability
- Increased egg quality and size

Broiler breeders

The breeding objectives of broiler breeders are to produce fast growing lean progeny, while maintaining good egg production. To produce fast growing lean progeny the broiler breeder must also be fast growing and lean. In the broiler breeders these two objectives are difficult to obtain as they are in conflict with each other.

Egg layers

The breeding objective for egg layers is to produce hens that are capable of efficiently producing a large number of eggs over their lifetime. Key selection traits for layers are body weight, growth rate, liveability, age at sexual maturity, egg weight, egg production, egg quality and feed conversion.

Importation of new genetics

In Australia new genetics are imported from the major primary genetics companies. Aviagen is the only primary genetics company with a base in Australia; great grandparent (Elite) stock is imported as eggs that are then hatched in quarantine.

There are some private importation facilities that can import grandparent stock directly into Australia, these are owned by the major commercial broiler integrators. The other commercial poultry companies must use the government operated quarantine facility at Torrens Island. New genetics imported through this facility can take up to six years.

Breeder nutrition and management

Breeder nutrition

Nutrition of both layer and broiler breeders is separated into two phases: pullet rearing to the point of lay and production.

Pullet rearing

The key nutritional objective during pullet production is to produce a well grown (frame size) lean, not too fat, bird that is sufficiently mature at the point of lay. Feeding is targeting body growth, skeletal maturity and good muscling.

Broiler breeders grow very quickly and have large appetites on very small amounts of feed, and as such there is a fine balancing act to optimize growth for egg production. To control feed intake a number of feeding strategies may be employed to restrict feeding, such as skip a day or 4:3 day feeding programs.

Egg layer breeders have small appetites and can be difficult to get to optimal weight, and to maintain weight while maintaining high egg production. Thus, feeding strategies are optimized to get to suitable body weight and frame size prior to the onset of production.

Skeletal maturity of breeders is critical for good egg production. Calcium deposited in the skeleton during growth is used as a calcium store to maintain egg production during the production phase. Over fat birds at the point of lay do not maintain good egg production past the point of lay, cost more to feed and have higher mortality. The quality of the pullet at the end of rearing is critical to achieving high egg production and good bird liveability.

Production feeding

For both layer and broiler breeders feeding from the point of lay through production is to ensure that each bird comes into lay, maximizes egg production and does not become too fat/thin. Over or under feeding during production has deleterious effects on egg production, fertility and persistency of lay, and affects bird mortality.

A key difference between broiler breeders and egg layers is the number of eggs that may be produced. Broiler breeders produce around 180 eggs to 65 weeks of age while egg layer breeders produce up to 280 eggs by 70 weeks of age.

Growth Targets	Broiler Breeder		Egg Layer Breeder	
	Body Weight (g)	Feed Intake (g/bird/day)	Body Weight (g)	Feed Intake (g/bird/day)
Week 1	150	35	65	13
Week 10	1600	75	820	56
Week 18	2700	101	1440	83 (5% Prod)
Peak	3570	160	1900	110
End of Lay 75 Weeks	4000	165	3000	112

*Guide only: specific recommendations depend on the breed and strain and nutrient density of feed

Parent breeder management

The management of breeders is broken into three key phases; brooding, rearing and production periods.

Breeder rearing and production are very similar at the different levels of the pyramid, with the brooding, rearing and management practices essentially the same. Key differences arise in the performance indices (weight, age at first egg, egg weight) and production (total egg production) or behaviour of the different bird lines.

Rearing and production may occur at the same site and shed, or birds may be reared in one shed and moved to another at the point of lay, where they will remain for the duration of production. Breeders are typically reared on the floor in barn type environments, but many different configurations exist. Elite birds may be reared or managed in small groups or individual pens or cages so that exact production figures may be obtained.

Brooding

The brooding period is from 1-4 weeks and is key to providing the best start for the rearing of good laying hens. Brooding conditions and water and feed management during this period are essential to providing a good start for chicks, ensuring they have low mortality, healthy immune systems and maximal body growth and uniformity. Poor brooding will impact on achieving objectives in the rearing period and production period.

Key objectives during brooding:

- Obtain correct body weight at 4 weeks
- Secure good frame development
- Establish good feeding behaviour, and development of digestive tract

Rearing

The aim during the 4-16-week rearing period is to prepare the birds for egg production with ideal development of body frame, bodyweight, uniformity and digestive tract. At the end of the rearing period birds are transferred to production facilities.

Growing period management objectives:

- Achieve steady body growth between 4 and 16 weeks
- Obtain good uniformity (80%)
- Achieve recommended body weight at 5% production.

Production

At the point of transfer birds are light stimulated to synchronise the onset of lay. Lighting programs differ depending on the location (latitude/longitude), the climate and season, and housing types. The key objective is to stimulate all birds into production (lay) at the same time.

The key objectives during the laying period are to manage bird weight to maximize egg production and fertility so that the maximum number of chicks are produced per breeder.

- Production Period Management Objectives
- Maintain steady body weight
- Maximize hatching egg production
- Achieve and maintain good egg weight (not too large)
- Maintain good egg fertility and hatchability

Production targets parent breeder stock

Production Target	Broiler Breeder (weeks)	Egg Breeder (weeks)
Age at transfer	19-20	16
5% Lay	24	18
50% Lay	26	21-22
Peak Lay	30	30
End of Lay	60-65	65

The first eggs produced are not usually set for hatching, as they are too small, have poor shell quality and poor hatchability due to size and fertility, and these first chicks are very small. As egg production is established eggs are then set for hatching.

The key differences in production performance between broiler and egg layer breeders are summarized in the table below. Egg breeders typically have much higher hatching egg production than broiler breeders, which come into production at an older age and sustain production for a shorter period of time.

Breeder performance summary

	Broiler Breeder ¹	Egg Layer Breeder ²
Female Liveability		94% (1- 18 wk)
	94% (24-65 wk)	92% (19-65 wk)
Male Liveability		90% (1-18 wk)
		42% (19-65 wk)
Age at 5% Production	168 days	112 days
Age at 50% Production	180 days	147 days
Peak Hen-day production (age)	82% (30 wk)	91% (30 wk)
Number of Hen-day Eggs		270
Number of Hen-Housed Eggs	178	260
Number of Settable Hen-Housed Eggs	170	221
Number of chicks produced	145	161
Average Percent Hatchability	86%	73% (25-65 wk)
Female Body Weight	3 kg	1.46 kg
	4 kg	2.06 kg
Male Body Weight	4 kg	2.13 kg
	5 kg	2.7 kg

¹Cobb SF Parent; ²Hyline Silver Brown Parent