

CHAPTER 3

Ongoing Selection of Breeding Stock

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This outline for selecting desirable production traits in chickens was developed as part of an American Livestock Breeds Conservancy pilot project to recover breed production characteristics of endangered poultry. These guidelines are from well-established parameters developed by “old school” poultrymen, as documented in some of the early to mid-20th century poultry texts. This once commonplace knowledge and practice has become unknown to most modern chicken farmers due to the ready availability of chicks that can be purchased from large hatcheries.

The following information can be used by the producer to identify birds that would be good candidates to retain for breeding stock. Keep in mind that any bird that is selected for breeding must also meet the established historic standards for the breed. These historic standards were written at a time when chicken breeds were being used for commercial production within several production systems. Input from the top breeders of each breed was used to establish the particulars of size and other qualities that would produce the best specimen for the role each breed was designed to fulfill.

A producer needs to retain far fewer males than females for breeding stock. With this in mind, rigorous selection of the males is an important component to a sound, breeding program. It should also be remembered that adult size is controlled by the size of the female stock – undersized or otherwise poor quality females should not be retained. Therefore it is better to hatch more chicks from fewer hens than to retain undersized or poor quality hens.

Understanding the historic role of the breed being evaluated is critical to success if the breed is to serve in the purpose for which it is designed. Dual-purpose breeds, such as American breeds like the Buckeye, Delaware, New Hampshire, Plymouth Rock, and Rhode Island Red, should have equal consideration given to egg production indicators as to meat considerations in order to retain their practical usefulness. Egg-laying breeds, such as the Leghorn, Minorca, or Ancona, should have more emphasis placed upon the sections of their bodies devoted to egg production, but will still benefit from a

sound overall appraisal. Because there is a link between the breed, the environmental system for which it is designed, and the products the breed is meant to produce, selection of breeding stock should favor those animals that excel within conditions in which the breed is meant to be raised. In other words, when planning to use a breed designed for range-based production, an animal that grows quickly in confinement should not be favored over a slightly slower growing or smaller animal that was grown on pasture. In such a case, the differences between the production systems, and not genetic differences, may cause the differences between individuals. Comparison of individuals within the same system does correlate, to a large extent, to selection based upon a measure of genetic makeup, and thus breeding potential and quality.

In 2006 and 2007, ALBC worked with Buckeye chickens and developed a model for the recovery of production characteristics within endangered chicken breeds. Through this work, it became clear that the key to success was in selecting birds for six basic qualities: rate of growth, mature size, egg-laying ability, breed type, color, and fertility and vigor.

Basic Qualities for Selection

1. Rate of Growth – Speed of weight gain influences profitability and can indicate strength of the immune system of the bird as well as suitability for system of production. It is a well-documented fact that both excessively fast growing and extremely slow growing poultry have less robust immune systems. Excessively fast growing birds can be more prone to diseases because of thinner gastrointestinal tracts which allow both faster nutrient uptake as well as easier penetration by bacterial, and possibly viral, agents. Historic level of productivity is a good guide for optimum rate of growth for the breed under consideration. For many of the American breeds, historic rate of growth, i.e. the time it takes to grow to processed size and weight, is between 12 and 18 weeks of age – with the majority of breeds falling toward to the higher end of this range. Rate of growth must also include fleshing; as it matters not how large and heavy a chicken is if it has no flesh when it is processed.

2. Mature Size – The ideal weight for each breed is outlined in the American Poultry Association’s *Standard of Perfection*. The figures given are an ideal with a permissible range of plus or minus one-half pound. It is important to remember that mature size also refers to the fleshing in the economically important sections of a bird’s body. In order to reach ideal mature size, the bird should reach desired weight and have ample flesh in the sections important for that breed. The weights and body proportions given were determined by the top poultrymen of their day, who used these breeds commercially and identified the most productive fowl for the systems and used this knowledge to create the standard descriptions.

3. Egg-laying Ability – Chickens that do not lay eggs do not reproduce. Egg-laying ability is an important economic consideration – fewer breeding hens are needed to produce a given number of offspring when the hens lay large numbers of eggs. Selection for egg-laying ability is a trait of primary importance in egg-laying breeds, of significant importance to dual-purpose breeds, and of some importance even in meat producing breeds – though high egg production and high rate of growth are not completely compatible traits. Most breeds will begin to lay at around six months of age. It has been found that selecting for earlier production reduces adult egg size. Rhode Island Red breeders have

found superior overall health and production in pullets that begin to lay at or near six months of age over those that begin to lay at eight to nine months of age.

4. Breed Type – As stated above, the American Poultry Association’s *Standard of Perfection* outlines the ideal of the breed. Type is comprised of body shape and conformation and is important because it affects the size and shape of the internal organs and the distribution of flesh, and thus the breed’s suitability for the system of production. Breeds like the Wyandotte, Buckeye, and New Hampshire have rather compact but deep and wide bodies. Such bodies are ideally suited to retaining heat, so it should be no surprise that these breed do well in cold regions. The Leghorn, Ancona, and especially Minorca tend to be rather longer and narrower proportionally and are well suited to hot climates, reflecting their Mediterranean origins. But Leghorns are also designed for egg production primarily, whereas Buckeyes should produce eggs and meat. So breed type is an important consideration for purpose as well as regional adaptation.

5. Color – You can’t eat color. So why should any consideration be placed on this trait? Color can and does impact a breed’s suitability for different systems of production. For example, while white chickens are healthy and will do well on pasture, white chickens are slightly more prone to predation. Color can also be an



Notice the outline of this Rose Comb Dark Brown Leghorn: full deep breast; long body; deeper in the rear where the egg organs are located; and legs set in the middle of her body. Such a hen will be productive for many years. Photo courtesy of Paul Gilroy.



Notice the outline of this American Game hen: full large breast; narrow, pinched saddle area (where egg organs are located); and shallow body evenly deep. Such a body is designed to produce large breast muscles but is not suitable for sustained production of eggs.



Notice the compact body found on this Delaware. Such a body retains heat well, but is only productive if large capacity is maintained with exceptional width and depth of body.

indicator of breed purity, and therefore an indicator of the genes that gave the breeds the abilities for which it is noted. Historically, individual strains sometimes had slight differences in color which were valued for giving the ability to identify and discriminate – a breeder might recognize that a given bird was not a pure representative of a particular strain, and therefore may not produce the desired results expected of that strain.

6. Fertility and Vigor – No animal that exhibits a lack of vigor or good health or which proves low in fertility should be used as breeding stock. The only exception is when salvaging a rare line, variety, or breed. High levels of vigor and fertility are the foundation upon which economic value is built. Both of these traits are of the utmost importance and together they give the breed the ability to withstand challenges – including inbreeding or disease.

Culling

An entire book could be written on culling. It is the single most beneficial practice that poultrymen can use to better the quality and health of their flocks. An old saying is that the best tool you can use to improve the quality of your birds is an axe! This applies to immune



Rhode Island Red chickens maintain capacity by being long, deep, and broad in their bodies. Notice the size of the comb on this rooster; such a comb indicates excellent egg production for his daughters. Photo by Don Nelson.

function as well as production, type, and feathers.

A well-known Leghorn breeder and poultry judge, Mr. Richard Holmes, used to tell a story about a master breeder of White Leghorns who in his early years hired an older poultry judge to come and cull his flock. The old judge locked himself in the poultry house and started catching and killing Leghorns. The story goes that the discards came fast and heavy. When the judge was finished the breeder had only one trio left out of 150 birds. The breeder later commented that from that day forward he made progress!

Disease Resistance

- The old-time breeders used to say to never use a bird in the breeding pen that had been medicated that year. While the bird may seem healthy, that the bird suffered disease is one indicator of low immune function. Also, in some cases of disease, the symptoms may have dissipated but the animal may not have completely recovered.
- Culling all birds that become sick is one way to positively select for disease resistance in breeding stock within the region in which the flock is located. Many



The chicken on the left has medium-sized feet and somewhat narrow shanks. The chicken on the right shows large feet and thick shanks – a sign of vigor and good health.

poultry breeders have found that after a few generations of culling all sick birds, illness will no longer be found in the flock. This practice should not be expected to work for highly pathogenic diseases.

- Master breeder of Brown Leghorns, James P. Rines, Jr., said many times, “Your flock will have only what you tolerate.” This saying can be broadly applied to all aspects of breeding, including disease resistance.

Vigor

- Selecting for vigor requires selecting from amongst the dominant cockerels and pullets when choosing future breeding prospects.
- Select male and females that have bright red combs without dark tips. Dark tips can be an indicator of heart trouble.
- Select birds with bright, strong eyes with well-formed irises and correct eye color for breed. Some diseases, such as leucosis, prevent the iris from forming a nice round shape and may leave the eye off colored.
- Very active and animated individuals are often highly fertile and vigorous.
- Birds that have thick, well-fleshed shanks for their breed tend to be more vigorous.
- Fertility into old age and longevity are indicators of vigor.



A wide back leaves more room for egg organs and intestines. When wishing to maintain egg production within a line, males should be appraised for width of back as shown in this photo.

The Law of Ten

Quality versus quantity. It is an old breeding axiom that improvements and high quality are found in small portions of a population. The law of ten states that in order to find one good representative, ten must be produced; to find one great individual, one hundred must be produced; to find one exceptional individual, one thousand must be produced. Retaining only the top ten percent each season will allow a breeder to make progress toward their desired goal.

As ALBC began work on the Buckeyes, culling was organized such that the best representatives from each mating were retained so that no mating was favored over all others, even ones that produced more superior individuals. This approach allowed progress in productivity to be made while still retaining much needed diversity in the breeding population. The law of ten was also applied by retaining as breeding stock only those individuals that made it to the top ten percent of those produced that year. Three years of breeding represented significant progress and overall increase in quality of the stock produced.

Some Other Breeding Points

- Monroe Babcock, creator of the Babcock B2000 commercial egg-layer, recommended using hens for breeding that lay before 10 am. He noted that such hens tend to lay more eggs, and are generally healthier and long lived.

- Eggs from the best layers tend to hatch as well or better than those from poor layers.
- Evidence indicates that breeding from only two-year old and older hens increases longevity and reduces mortality within a strain.
- Keep track of your most productive hens. Sons from these hens should be favored during selection and mated, when possible, to hens that lay near the top of your flock's ability in order to produce highly productive offspring.
- First- and second-year egg production should guide retention. Hens with high records from these two years should be used as long as productive.
- Malposition of chick or air cell accounts for chicks that do not make it out of the eggshell – this is highly heritable. Cull all chicks that are unable to hatch unassisted.
- Overly large eggs result in chicks that have faults such as extruded yolks and other incubator-related weaknesses and hatchability problems. Placing too much emphasis on large egg size can result in poor hatchability for your flock.
- Rough, coarse comb texture can be linked to reduced fertility.

Applying Selection

Though there is an annual cycle to breeding, there is also an entry point and a desired goal when improvements are needed. Below is a sample breeding plan for dual-purpose poultry, which can be adjusted to fit the particulars of any poultry breed.

Year One

- Hatch. If attempting to make progress, it is best to hatch in sufficient numbers to allow selection and retention of superior individuals rather than maintain the status of the strain. By understanding the law of ten, it is easy to see that a target of thirty offspring should be set to simply find one good trio – sixty to find two trios to retain as breeders.
- In the first year, selection should be harder on male offspring than females when starting from a small group. In the Buckeye work, the first year produced only five pullets – thus all five had to be retained as breeders for the following spring.

- Do not weed out different lines. Try to hatch enough offspring from each line so that diversity may be conserved while selecting the top ten percent for retention.
- Evaluate the young birds for rate of growth. For the Buckeyes we choose 16-week weights and evaluations as ideal because this age was a good choice for selecting potential breeders, and because the young birds would be at or near processing age. Superior birds should be banded for retention.
- Keep records of egg laying, fertility, and molting ability of the parent stock used. Mark individuals that excel in any of these qualities and retain for use again in year two.

Year Two

- Set up matings to avoid close inbreeding and to make good use of the genetic diversity available.
- In late February appraise the hens and mark those that have begun production and which indicate potential superiority as appraised for egg laying ability. These should be retained for continued use as breeders.
- Also in February, appraise the males for the potential to pass on good capacity for egg production in their daughters and make notes as season progresses on fertility.
- Adult weights should be taken in March or April, as at this time all cockerels and pullets retained from the previous season should be approaching adult weight. Compare weights with standard requirements for the breed.
- Hatch. Again, allowing for selection of the top ten percent. Ideally, produce 10-30 chicks per female used so that hens can be evaluated as well as males for the quality of their offspring.
- Evaluate young birds at 16 weeks of age. Mark superior individuals and compare to last year's appraisals.
- During the late summer, observe the molting of the adult birds. Make note of individuals that molt in late August or September and those that drop all their feathers at once. Preference should be given to these individuals.
- Throughout the year make note of egg laying, fertility, and molting ability of parent stock.
- Cull parent stock as necessary to retain quality for egg production, rate of growth, fertility, and diversity while fitting flock size to facilities.

- Appraise all retained breeders for proper type for breed – special emphasis should be placed that females have correct type.

Year Three

- Set up matings.
- Appraise cocks and hens in late February as before.
- Weigh adults.
- Plan hatching to facilitate desired number of offspring and good quantity from each hen.
- Evaluate young stock – same age as previously. Set minimum requirements for rate of growth that all young must achieve to be retained – this will likely equate to year one's better rates of growth.
- Evaluate molting of parent stock as before.
- Cull adult males based on a combination of rate of growth, capacity for egg production, adult size compared to the standard for breed, fertility, and vigor. Color may be included at this stage if numbers allow.
- Appraise all retained breeders for proper type.

Year Four

- Continue as in year three, but minimum requirements should be increased.
- Eggs may be culled for size and shape before being placed in the incubator, though pullet eggs should be compared only to other pullet eggs and not hen eggs for size.
- Consistency of size, rate of growth, and color should be more apparent in young stock.

- Color and plumage quality will certainly be considerations for young males this year.

- Parent stock that continues to meet requirements should be retained in the breeder flock as long as viable.

Year Five

- Continue as in year four.
- Eggs may be culled for color before being placed into the incubator.
- Females may now be culled based on color and plumage as well as males.
- Minimum requirements may need adjustment.

Summary

Breeding is not simply a static, intellectual pursuit, but requires a certain level of creativity and flexibility. The choices made by the individual breeders not only help to mold a strain of poultry, but they can be a source of pride and satisfaction for the effort of managing the breeding stock. Breeders should feel empowered to tailor choice of selection criteria to fit their desired goals and needs.

However, there are some basic ideas that should be kept in mind as you progress. In the first year of selection there is much advantage to emphasizing rate of growth and body capacity. Males in particular must be viewed not only for their obvious positive qualities, but also for their potential to produce both excellent sons and daughters. To that end, appraising males as if the were hens in production of eggs greatly supports the maintenance of egg production within the strain. It is better



Healthy, robust chicks should be the goal of every breeder.



A nice pen of Buckeye chickens showing deep, productive bodies.

to keep your second best cockerel for breeding if he is close to the best male for rate of growth and fleshing, and if he has superior width in the back and a larger distance between keel and pelvic bones. Such a male will produce offspring that will grow well and lay well. It is also best to give small consideration to fine points, such as color, in the first few years. As progress in other areas is made, emphasis can be added first to male offspring and in later years to female offspring.

There are some cautions worth considering that help to make sound long-range decisions. Intelligent breeders must keep in mind their long-range goals and avoid shortcuts so that the final result is a strain that has the diversity to stand on its own while producing as expected. Much faster progress can be made by discarding matings that do not excel for the traits focused upon, but later the diversity these “lines” lend is well worth the effort to bring them up to the levels of the other lines of the strain.

Resources and Suggested Reading

American Standard of Perfection, the American Poultry Association, various editions.

Hogan, Walter, *The Call of the Hen*, American Poultry School, 1914.

Rice, James E., *Judging Poultry for Production*, John Wiley & Sons, Inc., 1930.

Jull, Morley A., *Poultry Husbandry*, McGraw-Hill Book Company, 1938.

Jull, Morley A., *Poultry Farming EM820*, McGraw-Hill Book Company, 1945.

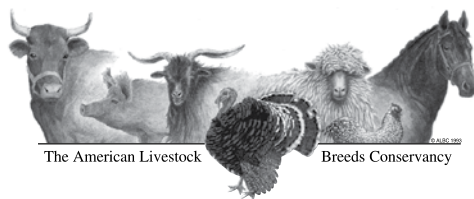
Jull, Morley A., *Poultry Breeding*, John Wiley & Sons, Inc., 1952.

Warren, Don C., *Practical Poultry Breeding*, The MacMillan Company, 1953.

Lamon, Harry & Rob R. Slocum, *The Mating and Breeding of Poultry*, Orange Judd Publishing Company, Inc., 1927.

Hutt, F.B., Ph.D., D.Sc., *Genetics of the Fowl*, McGraw-Hill Book Company, 1949.

Hagedoorn, A.L., *Poultry Breeding*, Crosby Lockwood & Son LTD, 1953.



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