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Review on Flock Improvement through Genetic Selection and Culling of Laying Flock of Poultry Production

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Abstract
This study reviews the improvement of layers through genetic selection and culling from the laying flock, with the aim of delivering summarized information for the beneficiaries and reader. Poultry production is increasing globally due to increase population number and increased demand of poultry products. Poultry production plays a great role for the supply of egg and meat from rural and urban area as a source of small holder family income. Even though all chickens are not equal in reproductive and productive performance, there is detrimental factor for the increment in poultry egg production by genetic improvement of laying flock through selection of the best layers and culling of undesirable or unproductive chicken from the flock by considering different parameters for egg production such as (age at sexual maturity; weight at maturity; body weight)
Keywords: flock, layers, culling, selection, and production.

1. INTRODUCTION

Genetic Selection is the basis of poultry flock improvement. The average number of eggs per hen and the cost of producing these eggs are of greater importance than the number of hens when profits are figured. Maintain high average egg production and lower cost of production by continuous rigid culling (Ebraheem Altahat, 2012)

For the average poultry raiser pullets can be culled only on the basis of breed type, color, vigor, vitality and other Standard qualifications. Egg production ability is not readily apparent in external body characteristics until the bird has been laying for some time. Culling on the basis of health should be a continuous "year-around" practice. Egg production is primarily a matter of breeding and secondarily a matter of feeding, housing and management. Vigor and vitality are the most important factors to be considered. Without these qualities, profitable egg production, longevity, resistance to disease and breeding ability are impossible. More eggs from the same number of hens will result from careful selection of breeders. The same number of eggs from fewer hens should be the result of culling. Genetic selection helps to continuously improve the laying performance, efficiency, livability, and adaptability of the birds to different environments as well as egg quality (Preisinger and Flock, 2000). For this purpose different traits are included in the selection of the laying hen breeding programs

Culling is the practice by which poor producing and undesirable hens are eliminated from the laying flock and the good producers and most desirable birds are selected for further use. Undesirable individuals, from the standpoints of health, vigor, vitality or any other readily distinguishable condition, are no longer of value and should be eliminated as soon as detected.

Culling applies not only to hens but also to hatching eggs, baby chicks, growing pullets and breeding males. Performance improvements in a laying flock can be got from selection and culling decisions made during the year. Culling and selection are two sides of the same coin. Selection implies picking few to use from many while culling implies eliminating few from many (Oleforuh-Okoleh, V. U. (2005-2011).

Accurate selection and culling of hens from the laying flock are the best methods of improving the whole flock through increasing egg production and productiveness either by the quality or quantity of egg production (Ebraheem Altahat, 2012)

Objective

- To review flock improvement through genetic selection and culling of laying flock

2. Improvement of Laying Flock through Genetic Selection and Culling

2.1 Egg production in layers

Laying hen" is a common term for a female, grown chicken that is kept primarily for laying eggs or for egg production purpose. The egg production of a chicken is a result of many genes acting on a large number of biochemical processes, which in turn control a range of anatomical and physiological traits. With appropriate environmental conditions (nutrition, light, ambient temperature, water, sound health, etc.), the many genes controlling all the processes associated with egg production can act to allow the chicken to express fully its genetic potentials (Fair full and Gowe, 1990).During the production cycle many factors influence egg production; therefore, the cycle must be managed effectively and efficiently in order to provide maximum output and profitability.

According to Alganesh et al., (2003) the egg production potential of local chicken kept under village management conditions, is 30-60 eggs/year/ hen with an average egg weight of 38g while exotic breeds of

chicken kept under intensive condition produce around 250 eggs /year/hen with average egg weight of 50-56g . The egg production performance the Egyptian Fayoumi, Rhode Island Red and White Leghorn was reported to be 156, 185 and 176 eggs/year respectively (Abraham and Yayneshe,2010).

Alemu (2014) reported that average egg production per clutch per hen of exotic chicken (RIR) was 38.5 and 45.2 in lowland and highland agro-ecological zone of central Tigray, respectively. Lemlem and Tesfaye (2010) reported 173eggs, 185 eggs and 144 eggs /year/ hen for White leghorn, Red Island Red and Fayoumi chicken under village household condition. Demeke (2004) also reported 82 eggs/hen for White leghorn under rural household condition with supplementary feeding. Geleta et al. (2013) indicated that egg weight of Fayoumi chicken under Adami Tulu Research center (44.3 g) was similar to Fayoumi (43 g) but lower than egg weight of Rhode Island Red (52.5 g) and White Leghorn (52.1 g) as reported by Abraham and Yayneshet (2010).The following factors influence egg production.

2.1.1 Body weight

Body weight is regarded as a function of framework or size of the animal and its condition (Phillip, 1970). One of the main factors influencing egg size is body size (Robinson and Sheridan, 1982). Variation in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individuals (Ayorinde and Oke, 1995). The poultry producer wants birds of minimum possible size and weights that will maximize production of standard sized eggs at an economic rate and still maintain market carcass value at the end of the production period (Oke, *et al.* 2004). Body weight in poultry is known to be moderate to highly heritable and hence the selection of heavier individuals in a population of Nigerian light local chicken ecotype for example, should result in genetic improvement of the trait. Though various factors are known to affect egg production, there are conflicting reports on the effect of body weight on egg production. Evidence obtained by Du Plessi and Erasmus (1972) indicated that larger hens within a bloodline laid larger eggs than those with smaller body weights. Telloni *et al*. (1973) found that hens carrying the dwarf allele (dw) laid fewer eggs than the normal hens (dwB), even when hens of the same body size were compared. However, Quemenur *et al.* (1988), cited by Fairfull and Gowe (1990), reported that dwarf broiler females lay as well as normal broiler females. Various findings using broiler birds in egg production experiment tend to suggest the possibility that the lower egg production of dwarf chickens may be due to close linkage of the dwarfing gene and genes determining egg production on the sex chromosome. For the development of egg production strains within the local chicken, it is necessary to establish the nature of the relationship existing between body weights of the local chicken and egg production parameters (Ebraheem Altahat, 2012)

2.1.2 Age at sexual maturity

The age at which a hen begins to lay eggs affects the total egg production in its life cycle, all things being equal. Selection of laying hens is normally based on partial records; improvement in production occurs largely in the first part of the laying cycle. Khalil *et al.* (2004) found that selection of hens with lower age at first egg leads to improvement of performance of egg production. Nwagu *et al.* (2007) obtained a positive response in a female line population which they attributed to reduced age at sexual maturity. Liljedahl and Weyde (1980) had reported that contribution of age at sexual maturity to response to selection lies between 50 and 80% over 4 generations of selection. Age influences egg production especially within the first laying cycle and over the subsequent laying cycles (Gowe and Fairfull, 1982) in each laying cycle, egg production (per hen housed or per live hen) quickly rises to a peak and declines slowly thereafter to the end of the cycle, usually terminating with a natural or induced molt. In successive cycles of egg production, the peak egg production of a flock is usually lower and the rate of decline of egg production is more rapid (Fairfull, 1982). In other words most traits deteriorate with advancing age. The decline in weekly egg production throughout the cycle is well studied (Gavora *et al.*, 1982; McMillian *et al.*, 1986; Yang *et al.* 1989). Thus, within egg production cycles, egg production declines with increasing age while its variation increases.

2.1.3. DISEASE

Disease affects egg production through mortality and morbidity (sub-clinical and clinical disease, inadequate nutrition, toxic elements, etc.). Mortality reduces the number of layers available to lay eggs, and morbidity reduces the laying ability of affected hens (Fairfull and Gowe, 1990). However the effects of morbidity and mortality on egg production records depend upon the age of the hens when affected. For instance, if birds are affected towards the end of the production period, little is lost in terms of economic returns in egg production, however, infection or conditions of instability in hens before or about their peak period of egg production would greatly affect the overall egg production records.

2.1.4. Breed

The breed of the laying bird influences egg production. Management and feeding practices, however, are the key determining features for egg production.

2.1.5. Laying house

The laying house should be built according to local climatic conditions and the farmer's finances. A good house protects laying birds from theft, predation, direct sunlight, rain, excessive wind, heat and cold, as well as sudden

changes in temperature and excessive dust. If the climate is hot and humid, for example, the use of an open house construction will enable ventilation. The inside of the house should be arranged so that it requires minimum labour and time to care for the birds.

2.1.6. Lighting schedule.

Egg production is stimulated by daylight; therefore, as the days grow longer production increases. In open houses, found commonly in the tropics, artificial lighting may be used to increase the laying period. When darkness falls artificial lighting can be introduced for two to three hours, which may increase egg production by 20 to 30 percent.In closed houses, where layers are not exposed to natural light, the length of the artificial day should be increased either in one step, or in a number of steps until the artificial day reaches 16 to 17 hours, which will ensure constant and maximized egg production. Effective day length should never decrease during the laying period.

2.1.7 Feed.

Free-range hens will produce more meat and eggs with supplemental feed, but only if they are improved breeds or crossbreeds. The selection of local hens is done on the basis of resistance and other criteria rather than feed utilization for production.

2.2 Genetic selection of laying flock

The choice of allowing individuals to become parents for next generation is selection or it is identifying the most appropriate birds to become the parents of the next generation .In other words differential rate of reproduction is also called as selection. It is necessary to maintain or increase variation in population and one of the important forces for genetic improvement. In poultry, genetic economic value of a layer bird depends on many traits like age at sexual maturity, body weight, number of eggs produced and weight of egg and the main objective of the layer breeding programme is to bring improvement in layer traits such as egg number, egg weight, fertility, hatchability, egg quality, feed efficiency and viability. One of the key factors to improving your chicken (layer) flock is to decide on what traits you want to improve as you breed each generation (Laly John; 2005)

Effective selection should be based on five characteristics, which are better guides than body shape or conformation. These characteristics are as follows: Earliness of maturity, indicated by age at laying of first egg; Rate of egg-production recorded by trap nesting or indicated by bleaching of beak and shanks in yellow skinned breeds; Absence of broodiness; Persistence of production, indicated by laying in August and September at the end of the first laying year and Winter pause of short duration(C, L. J. 2005)

Methods of Selection

1. Individual selection

It is also called as mass selection. Because the individual is selected from mass (flock or large number) on its own phenotypic value and put together in mass for mating, it is known as mass selection. The system is adopted for traits of high heritability and expressed in both sexes, where it results in faster genetic improvement (C, L. J; 2005)

2. Family selection

The individuals are selected on the performance of their whole family. It is useful in case of low heritability characters like egg production and which is expressed in females only; similarly viability, where phenotype is not reliable indicator of genotype. The sire or dam family averages are compared to population mean and the whole family is either selected or rejected for higher or lower means, respectively. The system involves two types of selection, viz, progeny testing and sib selection(C, L. J; 2005)

2.1. Progeny testing

The individual is selected on the basis of performance of its progeny, i.e. sons and daughters. But the biggest problem with this system is the time consumed to obtain performance values of progeny. The part year production values, e.g. egg production up to 40 weeks of age can be efficiently used to overcome the difficulty of time consumption as it is positively correlated with full year production to make use of this selection system.

2.2. Sib testing

Sisters and brothers of individual are called as sibs. To avoid time consuming problem in progeny testing, individuals are selected on the basis of performance and appearance of their brothers and sisters. Similarly, to select birds for traits which are expressed in one sex only, for example, egg production which is expressed in pullets or hens, cockerels or cocks are selected on performance of their sisters.

3. Pedigree Selection

Pedigree is the record of an individual's ancestors including parents. This selection is also important because sample half of genes from each parent is transmitted to each of its offspring's. It is of immense importance in selection at earlier age, when traits in question might have not expressed themselves, i.e. its greatest applicability is in initial selection of sex-limited traits (Laly John; 2005)

2.2. Culling of Laying Flock

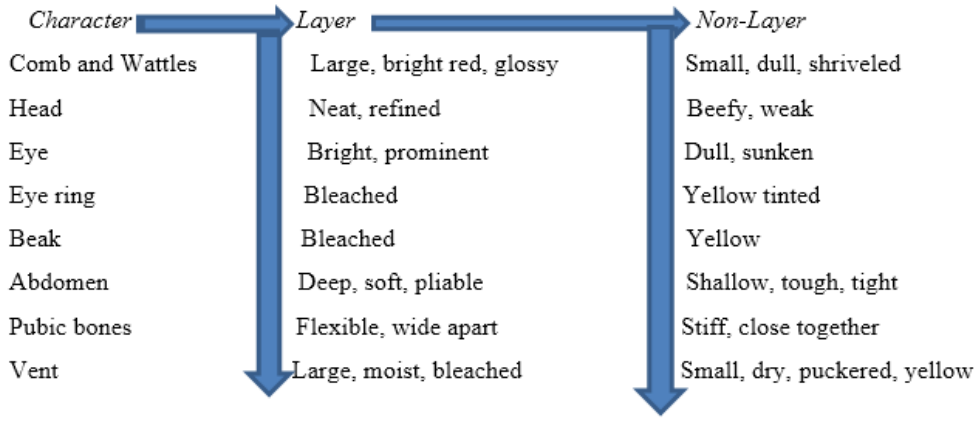
Culling in a practical sense means examining each hen in the flock at intervals near the close of the year's production and eliminating those of low vitality, beefy disposition, and unmistakable evidences of low production. The detection and elimination of these low producing individuals is called culling. Culling is one of several necessary phases of successful poultry management. Culling should begin at the time eggs are selected for incubation; weak, malformed, and undesirable chicks should be culled when transferring from the incubator to the brooder; chicks that are of low vitality should be culled as soon as discovered during the developing period; and pullets that are a few months later in starting to lay than the average of the flock should be culled. Individual cull hens should be removed at any season of the year they are definitely detected((I. Rozempolska-Rucińska1, 2010). Intelligent culling of the poultry flock is of the utmost importance for success in poultry keeping. The main purpose of culling of laying birds from laying flock (Ebraheem Altahat, 2012)

- ✓ it increases the profits by insuring that the feed will be consumed by the better producing hens or the profit payers, and will not be consumed by the poor producers which are kept at a loss
- ✓ it makes it possible to save those best suited for breeders, both on account of their better production and on account of their superior strength and vitality, which have enabled them to stand up under the severe strain of heavy laying
- ✓ culling out the poor hen gives those left more room and a better chance

There are two methods of culling:

- mass culling, when the entire flock is removed and replaced at the end of the laying cycle; and
- selective culling, when the farmer removes individual unproductive or sick birds

Characteristics Indicating Ability to Lay



Factors to be considered during Culling of Laying Flock

1. Value of Vigor and Health

Vigor is the very foundation of a successful poultry business. An active disposition, bright, clear eye, and well-worn toenails indicate health. Small, weak, deformed inactive hens with long beaks and heads lack vigor and should be culled. Hens with baggy abdomens have broken down and become very fat; when they stop laying they seldom start again and the death rate is very high. Hens that are large and coarse with small sunken eyes are big eaters, poor layers, and rightly belong to the "beef" class.

2. Value of Yellow Pigment in Culling

In yellow-skinned breeds the same yellow pigment that colors the yolk of the egg colors the vent, eye ring, beak, skin, and shanks. As the hen starts laying this yellow pigment begin to disintegrate and disappear. The different parts of the body fade out white in proportion to the amount of pigment stored in those parts, the kinds of feed fed, the weight of the body, the size of egg laid, and the length of the production period.

After production begins the skin around the vent is the first to whiten, then the eyelids, the earlobes, the beak, and last the shanks. When a hen stops laying the color returns in the same order that it leaves; only very much more rapidly. The loss of yellow color in the shanks indicates a long laying period, which varies from three to six months, depending on the breed, the rate of production, size of egg, and kind of feed. The presence or absence of yellow pigment in the vent, eyelids, earlobes, and beak denotes a shorter laying or resting period, varying from a few days to four or five weeks.

3. Value of Molt in Culling

A hen usually starts molting at any time of the year she stops laying. Poor inherent breeding or poor management may cause her to stop laying. The later a hen lays in the summer the greater has been her annual production and the later she will molt. Hens of poor breeding stop laying early and start to molt ; contrary to old-time opinion, these hens do not make the fall and winter layers. Hens of general-purpose or meat breeds frequently lay and

molt at the same time. High-producing hens usually molt more rapidly than low producers. The best layers have dry, ragged, frayed, and brittle feathers, and the tail feathers are badly worn during summer and fall months. The number of new or old feathers in the wing primaries is a safer guide in determining the molt of hens that can be found in other parts of the body. It takes about six weeks to renew the primary feather next to the axial feather and an additional two weeks for each subsequent primary feather. If more than one growing primary feathers are the same length they should be credited only with the growing time of one feather. The poor layers will have more new primaries in July and August than the high layers. Heavy fall and winter egg production should be expected only from early hatched, well-matured pullets. There is no practical value derived from forcing a flock of hens into an early summer molt in an attempt to obtain from them a high fall and winter production. While late-molting hens are practically certain to be the best layers during the following year, it is not advisable to go to extremes in selecting the laying flock by this factor. The net returns from the medium-late molters may be as great or greater than from the extremely late molters. Loose feathering is usually a characteristic of the coarse, late-maturing, and low-producing hens. Loose feathering is often a characteristic of birds reared in confinement and of hens kept in laying cages. Any factor of mismanagement that checks egg production in summer will force the molt, and such conditions must be given due consideration by the person culling the flock (Ebraheem Altahat, 2012)

4. Value of Body Changes in Culling

The laying hen has a large, moist, dilated vent as contrasted with a round, dry, puckered vent in the case of a hen not laying. In order to lay well a hen must be able to consume and digest a large amount of feed. The reproductive and digestive organs require a large amount of room. When a hen starts laying the entire abdomen becomes dilated; the pelvic bones, between which the egg must pass, become wide spread ; the keel is forced down, and the lateral processes are sprung outward. When a hen stops laying the measurements are materially reduced. Poultry men measure a hen's capacity by the perpendicular distance between the pelvic bones and the posterior end of the keel. This measurement, whether two fingers or six fingers, is influenced by the size of the bird, length of keel, size of eggs laid, and whether the hen is laying or not laying at the time of examination.

With high production the fat goes out of the skin and the hen has a soft, velvety skin and very soft and pliable abdomen. Thick, blunt, crooked pelvic bones and deposits of hard fat in the abdomen indicate either low production or a long period of time since profitable production. The back should be broad and flat, and its width should be carried well back to the tail. A back that is narrow, curved, cushioned on top, tapering toward the rear or sloping down, indicates very poor capacity.

5. Value of Head and Adjuncts in Culling

Fineness of the head is an indication of a good laying hen. The face is clean cut; the eye round, bold, prominent, and set in an oval socket; and the wattles and earlobes fit close to the head. The comb is fine in texture, soft, and pliable; serrations are broad at the base and follow, usually, the general curvature of the head. The beak is short and well curved.

Unprofitable hens usually have long, narrow serrations on the comb, shrunken, hard to the touch, and covered with whitish scales. The eye is usually sunken, not prominent when viewed from the front, and has a dull, listless expression. The long beak and narrow, crow like head are never found on a high record hen.

6. Value of Temperament and Activity in Culling

A high-producing hen is more active and more nervous than a poor layer, yet more easily caught and handled. The high producer is friendly, while the poor layer is sly; stays on the roost or outer edge of the flock, and squawks when caught. The first hens off the roost in the morning and the last to go to roost at night are the best layers

CONCLUSSION

Genetic parameters of laying hens usually are estimated based on individual observations, for hens housed in single cages. However, in commercial egg production farms, hens are commonly kept in group cages. Performance improvements in a laying flock can be got from selection and culling decisions made during the year. Culling and selection are two sides of the same coin. Selection implies picking few to use from many while culling implies eliminating few from many. Genetic improvement is achieved when selected animals are genetically better than those they replace. Likewise, you get genetic improvement if those culled are genetically inferior to those you keep.

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