A simple linebreeding program for poultry breeders

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A Simple Linebreeding Program for Poultry Breeders

By C. W. Knox

A group of line bred females whose combined first year record was 1522 eggs.

AGRICULTURAL EXPERIMENT STATION
IOWA STATE COLLEGE OF AGRICULTURE
AND MECHANIC ARTS

C. F. Curtiss, Director

ANIMAL HUSBANDRY SECTION
Poultry

AMES, IOWA

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SUMMARY

1. High egg production is inherited.
2. Linebreeding seems to be the best form of breeding.
3. Linebreeding can be accomplished without trap nesting or the keeping of complicated records.
4. The foundation male must be a pedigreed one.
5. The foundation male’s pedigree must show successive improvement and high egg production for at least three and preferably four generations.
6. The colony eggs must be marked and kept separate.
7. The chicks should be toe-punched for later identification.
8. A simple method of linebreeding can be accomplished by mating a son of the foundation male to the granddaughters of the foundation male.
A Simple Linebreeding Program for Poultry Breeders

By C. W. Knox

It is practically impossible to increase egg production beyond a certain point in any flock of chickens without proper regard to mating and breeding. The old adage that it is impossible to squeeze blood out of a turnip also holds true in poultry keeping for, no matter how much care is given the birds, they cannot lay eggs beyond their HEREDITARY capacity.

As with egg production, hatchability, egg size and body weight cannot be increased beyond certain limits unless some constructive breeding program is followed. Altho this bulletin will deal with linebreeding for higher egg production, the same principles will apply for increasing hatchability, egg size and body weight.

In all probability, linebreeding is the best improvement method for the average farm poultryman to use. Linebreeding insures the breeder a uniform progeny and increases the percentage of desirable high-producing birds in the flock. Linebreeding also eliminates the necessity for purchasing new breeders each year. Such a system of breeding may be practiced by every farmer with practically no additional cost or work.

In the old type matings, in which a new male is purchased every year, the results in regard to fertility, hatchability, uniformity of size and egg production vary greatly from year to year. This chance result is largely avoided by using a linebreeding system. Systematic linebreeding rather than accidental mating should be practiced.

Altho linebreeding is a form of inbreeding, it avoids most of the dangers, especially that of poor hatchability, which usually results from the closer inbred matings; yet linebreeding retains many of the advantages of inbreeding, such as uniform size, type and egg production.

Many females have been produced at the Iowa Agricultural Experiment Station by this method of breeding. These females have had high egg laying ability and their body weights have been above the average. The eggs from these birds have been high in hatchability and of good size. The picture of one of these females, Lady Ames, is shown in fig. 1.

Lady Ames was an exceptionally well built pullet. She had a long, level back, extreme length of body, deep breast, deep abdomen, a beautiful head and prominent, large, wide-open eyes. She was an excellent example of the rectangular, tight feathered type of individual that is always sought for and seldom found. She was the first 300 egg bird produced by this station and her

* Paper No. 21 from the Poultry Husbandry Department.
record was 305 eggs in 365 days. This record was made without the use of artificial illumination. Her progenitors were of the very best and they were mated in such a manner, that she was line bred to the best individual male bird, No. 683, available at that time.

Another pullet, a year later, F1923, laid 322 eggs in 365 days. She also was line bred and her pedigree appears below. This pullet is singled out from many other White Leghorns, first, because she produced the greatest number of eggs; second, because she was line bred; and third, for the purpose of using her pedigree to illustrate the simple linebreeding program which is to follow. Most of the White Leghorns at the Iowa State College Poultry Experiment Station have been bred by this system. The average production for this breed in 1927 was 214 eggs. No birds were used as breeders in 1928 that did not lay 240 eggs, and in 1929 only those laying at least 260 eggs were used. These breeders had a hatchability of 70 percent of the total eggs set and their eggs were of good weight.

Several facts may be learned from the pedigree of F1923. It will be noticed that she, as was the case with Lady Ames, is line bred to male No. 683. This cock bird appears more than once in the pedigree. He appears as the great grandsire on the dam's

**Pedigree of Female F1923**

<table>
<thead>
<tr>
<th>Sire</th>
<th>Dam</th>
<th>Year 1st</th>
<th>Year 2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>379</td>
<td>D683</td>
<td>262 eggs</td>
<td>225 eggs</td>
</tr>
<tr>
<td>384</td>
<td>D275</td>
<td>244 eggs</td>
<td></td>
</tr>
<tr>
<td>683</td>
<td>D760</td>
<td>268 eggs</td>
<td></td>
</tr>
</tbody>
</table>

*No electric lights used

† The letters point out the year that the bird was hatched, the D series indicates the year 1923: E, 1924: F, 1925: G, 1926: H, 1927.
side and as the grandsire on the sire's side, and he was used as the foundation male. Because linebreeding is illustrated here with females that produced over 300 eggs each in a year's time, it does not mean that all that is necessary to produce a 300 egg bird is to line breed. No system of breeding, no matter how simple or good it is, will accomplish much without careful and intelligent selection, culling and mating. Furthermore, housing and feeding conditions must be of the best.

Hens must be selected according to egg production, size, type and color. Much greater care must be used in choosing suitable males and more rigid selection practiced than with females. This is especially true of the foundation male, for upon him rests the success of the breeding operations.

Males should be selected on the basis of type, color and size, but ancestry, especially in regard to egg production and hatchability, is the most important factor. The reason a pedigreed male should be chosen is that the pedigree aids the buyer in judging whether or not the male will meet his requirements. The male in fig. 2 has the desired breeding necessary for a foundation male. He is a son of F1972, another line bred 300-egg female. He has given excellent results. He has a long, level back, deep breast and abdomen, and is very broad.

The pedigree of a foundation male should be scanned very closely. A good pedigree is one in which all of the female ancestors show high egg production for at least three and preferably four generations. The average egg production of the females of each succeeding generation should show an increase. The pedigree of the male pictured in fig. 2 embodies all of these characteristics. His ancestry is shown in Pedigree No. 2 (page 214), which includes the average egg production of the females in each of the generations.

Males of this quality will probably cost more than the average poultryman has been paying heretofore, but as another need not be bought for at least three years, the breeder can afford to pay three times as much as for an ordinary male. For example, if a poultryman had previously paid 2 dollars for a male, he could now afford to pay 6 dollars; and if he has been paying 5 dollars,
Pedigree of a Good Foundation Male

<table>
<thead>
<tr>
<th>Sire–MG282</th>
<th>Sire–818</th>
<th>Dam–F1923</th>
<th>1st Yr. 322 eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dam–140</td>
<td>1st Yr. 256 eggs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sire–379</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dam–E1649</td>
<td>1st Yr. 196 eggs</td>
<td></td>
</tr>
<tr>
<td>HM550</td>
<td>Sire–318</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dam–140</td>
<td>1st Yr. 256 eggs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sire–544</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dam–166</td>
<td>1st Yr. 174 eggs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sire–545</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dam–3091</td>
<td>1st Yr. 237 eggs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average production 300

545 and 379 are sons of 683 not shown in the pedigree and E1649 is a granddaughter.

Pedigree No. 2

he should be willing to pay 15 dollars for a foundation sire. The fact that in three years time this male’s influence will permeate the entire flock makes it imperative for the breeder to secure a really worth while male.

The average poultryman with a small flock of 100 to 200 hens, upon seeing pedigrees such as that of F1923, will immediately state that such breeding involves too much work; that it is necessary to trapnest and keep a complex system of records which would use up all of his rainy days, and that such work should be left for the specialist and not for the man who keeps 100 to 200 chickens as a sideline.

This may be true in the case of F1923, but there is a method that the busiest farmer can use, which will produce practically as good results as that of the more complete system used with F1923. Because it involves neither extra work nor increased expense, the following linebreeding system is recommended.

First, it will be necessary to buy a good foundation male. For example, suppose a breeder buys a foundation male such as No. 683 or HM550. The first year the new male should be placed in a colony house, about 10 x 12 feet in size, with 18 hens, if they are White Leghorns; and 12 to 15 females for the heavier breeds. The exact number will vary with the season, breed and age of the individuals.

† The letters point out the year that the bird was hatched, the D series indicates the year 1928; E, 1924; F, 1925; G, 1926; H, 1927.
The foundation male should be used in successive years so that his sons can be mated to his granddaughters and in three years time produce line bred progeny. Such a system is given in pedigrees 3 and 4 which show both the cockerel and pullet lines.

The best hens can be selected from the owner’s flock of chickens and placed with the foundation male in a colony house. Then the remaining hens and the same year’s pullets can be placed in the flock laying house, fig. 4, and the poultryman is ready to start breeding the birds systematically. Pedigree No. 3 shows the cockerel line, designating a method of linebreeding by the use of
The Cockerel Line

The foundation male

Colony
15 best hens selected from 1929 colony and farm flock matings

Cockerels
from 1930 farm flock mating

Pullets
from 1929 farm flock mating

Year 1932 1931 1930 1929

Pedigree No. 3

The Pullet Line

Cockerels
from 1929 farm flock mating

Pullets
from 1929 colony mating

Year 1932 1931 1930 1929

Pedigree No. 4

Cockerels
as usual

Farm flock of 150 females

Foundation male

Colony
15 best hens selected from farm flock.

Cockerels
from 1929 colony and farm flock mating

Pullets
from colony mating

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males. A similar course of matings, Pedigree No. 4, is followed with the pullets from the same colony.

A colony mating this year, 1929, containing 15 hens mated to a foundation male, such a male as No. 683, should produce 40 to 50 cockerels good enough to use for breeders next year, 1930. These males are to be used in the flock mating only.

In 1930, the colony mating should be continued with the original foundation male (683) with the best hens from the 1929 colony mating. Cockerels secured from the 1930 mating can be mated in the spring of 1931 to the pullets from the flock mating which were sired by the sons of the colony male (683).

All the pullets bred from this mating (1931), which includes all the females of the flock, will be line bred. In this manner, the desired blood lines of the valuable foundation male (683) are bred into all of the birds in the farm flock. Chart I indicates the method of doing this.

It will be noted that Pedigree No. 3 resulting from this type of directional mating is essentially the same as that of the pullet F1923 shown in Pedigree No. 1. It does not give the numbers of the dams or their egg records, but it gives the needed information without the use of trapnesting and without the keeping of

Chart I. This plan is designed for the beginner in poultry breeding and involves a house for the larger part of the flock and one colony house for the special mating. After the hatching season the hens in the special mating may go back into the general flock.

The chicks from the special matings should be toe punched at hatching time to identify cockerels and pullets from the special pen.

Great care should be used in selecting the male for the special mating. It will pay to buy from a reliable dealer a male that shows desirable breeding tendencies such as standard type and color, good production backed by known records, and from a family producing stock that are prepotent in these factors as well as in high hatchability. By observing the performance of the offspring of this male, one may determine whether he should be used the second year; if he fails to breed properly a new male should be purchased. If the male shows the desired breeding qualities, he should be kept three years and then another bird even better than the first should be purchased.
pedigree records. Both pedigrees, F1923 and the simple line-breeding program, portray the use of the foundation male (683) as the grandsire and the great grandsire of the line bred pullets. The pullets from the colony mating can be bred in a similar fashion to that indicated by Pedigree No. 4. Their progeny will produce practically the same results.

This plan of directional matings can be continued in a great many ways, two of which are shown in pedigrees 5 and 6, respectively. If the foundation male (683) continues to live and function properly, he can be used the next year, 1931, while his sons are used on the general flock. The following year, 1932, his cockerels are used in the flock mating with his granddaughters, producing progeny which are his great granddaughters, and granddaughters, thus securing a uniform flock of pullets in 1933. This particular method of continuing to use a linebreeding system is shown in Pedigree No. 5.

In case the male dies, a method similar to the one indicated above can be used. This is shown in Pedigree No. 6.

In order to continue under such conditions it will be necessary to select the best male, in 1931, from the sons of the foundation male and use him in place of his sire. Most of these cockerels will, in all probability, be half brothers. The rest of the cockerels can be used in the flock mating.

The following year, 1932, cockerels from the colony unit (sons of the foundation male) can be used on the pullets in the flock

Ways of Continuing Linebreeding

<table>
<thead>
<tr>
<th>Year 1933</th>
<th>1932</th>
<th>1931</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colony</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 best hens selected from 1930 colony and farm flock mating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cockerels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>from 1931 colony mating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pullets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>from 1931 farm flock mating</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pedigree No. 5

http://lib.dr.iastate.edu/bulletin/vol22/iss258/1
Ways of Continuing Linebreeding

<table>
<thead>
<tr>
<th>Year</th>
<th>1933</th>
<th>1932</th>
<th>1931</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedigree No. 6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Foundation male**
  - Colony
    - 15 best hens selected from 1929 colony and farm flock matings
  - Cockerels
    - from 1929 colony mating (half brother to cockerels in farm flock mating)
  - Pullets
    - from 1929 farm flock mating

- **Foundation male**
  - Colony
    - 15 best hens selected from 1929 colony and farm flock matings
  - Cockerels
    - from 1930 colony mating (half brother to cockerel in colony mating)
  - Pullets
    - from 1930 farm flock mating

- **Foundation male**
  - Colony
    - 15 best hens selected from 1929 colony and farm flock matings
  - Cockerels
    - from 1931 colony mating (half brother to cockerels in farm flock mating)
  - Pullets
    - from 1931 farm flock mating

All the eggs, both from the colony and from the farm flock, can be marked with a number to identify them in the incubator. This mark can be placed on the small end of the egg with a lead pencil, as shown in fig. 5.

Very little effort is necessary to practice this system of breeding and practically no extra cost is entailed. All that is required in addition to the regular routine is to mark the colony eggs at the time of gathering, to keep the colony eggs in a separate compartment from the 18th day of incubation until the chicks are hatched, and then to toe punch the chicks in order to identify the colony chicks (progeny of the foundation sire) when they are mature.

The eggs collected from the colony mating can be marked with a number to identify them in the incubator. This mark can be placed on the small end of the egg with a lead pencil, as shown in fig. 5.
Fig. 5. The eggs collected from the colony mating can be marked with a number or with a date to identify them in the incubator.

now be placed in the incubator. After the eggs are candled on the 18th day, remove all the eggs which will not hatch, and separate the colony and farm flock eggs. A device must be used at this time to prevent the chicks that hatch from the colony eggs from mixing with those of the farm flock.

Such separation is easily accomplished by using a homemade wire basket made of 1/4 inch hardware cloth. Make the basket deep enough to allow the chicks freedom of movement and yet not so deep as to prevent the tray containing the basket and eggs from being replaced in the incubator. It should be made so that it just fits into the incubator tray. Such arrangements are shown in figs. 6, 7 and 8. A cover of the same material can be made.

Fig. 6. Incubator tray with pedigree basket.
Fig. 7. Incubator tray and pedigree basket at the 18th day of incubation.

Fig. 8. Incubator tray with pedigree baskets showing construction to avoid thermostat.

with about 1 inch of the edges turned down. The raw edges of the basket and cover should be bent over and hammered down making a smooth edge about 1/4 of an inch in size, figs. 6 and 7.

Care must be taken so that no part of the tray will interfere with the thermostat. If it does interfere, a section of the basket must be cut out and the cover made to fit accordingly, fig. 8.

This basket is not placed in the incubator until the 18th day when the eggs are candled and sorted into two groups, the colony eggs and the flock eggs. The colony eggs are then placed in the basket and the cover put in place. Following this, proceed with the incubation as usual up to the time that the chicks are ready to be removed.

When the chicks are hatched, remove the colony chicks together. Each colony chick should be toe-punched for the purpose of
identification later, so that the cockerels and pullets can be recognized and used in the proper matings. Chicks are easily toe-marked with a toe punch, fig. 9, which pierces the web between the toes. Care must be taken that the hole is clean cut and no particle of the web is left adhering to the opening because, in such cases the hole is likely to close.

A toe-marking record of baby chicks at hatching time has another advantage. If all the chicks hatched at one time are given a certain toe mark and all the chicks in the following hatches are given another distinctive toe mark, then, in the fall the exact age of every individual can readily be ascertained by referring to the record. If an efficient toe punch is used for this purpose, a large number of baby chicks can be marked in a short time. The system shown in fig. 10 can be used to designate the age or pen.

If it is desirable to use a new male of unrelated blood lines at any time, it can be done without injury to the original breeding
program. To fuse the two blood lines, the new male should be mated to 15 daughters of the original male. A mating of this kind will produce cockerels having 25 percent of the old male's influence and 50 percent of the new. These cockerels can then be used on the line bred daughters. The pullets from this mating will have a lesser amount of influence from the new male and retain a greater amount of the old males' blood, as in pedigree No. 7. These birds can be used to continue the line-breeding program.

Selection and intelligent matings must always accompany linebreeding operations. No success can be anticipated unless the breeding system used is accompanied by good feeding, housing and care.

The methods given here for farm flocks can readily be used by the poultryman who has 500 or more birds. The only difference is that it will be necessary for the larger breeder to have more than one colony mating in order to secure a sufficient number of good cockerels.

The breeder can expand these operations by keeping daily colony and flock egg production records, and by getting the yearly average for each. This average can be written into the pedigree

Using a New Male

<table>
<thead>
<tr>
<th>Year</th>
<th>Cockerels</th>
<th>New male</th>
</tr>
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<tbody>
<tr>
<td>1934</td>
<td>new male 50%</td>
<td>Line bred pullets</td>
</tr>
<tr>
<td></td>
<td>old male 18 1/2%</td>
<td>to old male</td>
</tr>
<tr>
<td></td>
<td>new male 25%</td>
<td>37 1/2% - old male</td>
</tr>
<tr>
<td>1933</td>
<td>Line bred pullets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>in flock mating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>old male 27 1/2%</td>
<td></td>
</tr>
<tr>
<td>1932</td>
<td>Pedigree No. 7</td>
<td></td>
</tr>
</tbody>
</table>

* Iowa Agricultural Extension Bulletins Nos. 146 and 147. Iowa Agricultural Experiment Station Circular No. 114.
and it will also tell the breeder whether or not there has been any improvement.

One could go a step further and trapnest the colony birds, keeping the individual hen records for the year. In this way a better basis for the selection of the males to be used on the main flock would be secured. This expansion could be continued until all the birds were trapnested and pedigreed, making the pedigree complete like that of the pullet F1923 previously described. Yet, the system of breeding would remain the same in all cases, and the matings would be made in exactly the same manner whether they followed the simple plan described here or the more complete pedigree like that of F1923.