Factors Influencing Egg Production

III. The Association of the Date of Hatch with Date of First Egg, Sexual Maturity and Egg Production in S. C. White Leghorns

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SUMMARY

1. The data show a positive rectilinear association between the date of hatch and the date of first egg.

2. The date of hatch seemed to have a very slight association with the age at first egg (sexual maturity).

3. A decided curvilinear association was found between the date of hatch and the number of eggs produced before March 1.

4. The data show a positive rectilinear correlation between the date of hatch and spring egg production (March, April, May and June).

5. The date of hatch has a curvilinear association with total annual egg yield.
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Poultrymen and investigators have always considered date of hatch a very important environmental factor having considerable influence upon egg production. The general practice of poultrymen in the middlewest is to hatch chicks on dates ranging from February to July. The most common months for hatching White Leghorns, however, are March, April and May. It is usually considered that chicks hatched too early will go into molt during the winter months at which time they cease production, and that those hatched too late are handicapped by laying too few eggs for the winter period.

There have been several investigations made of the association of the date of hatch with egg production. One of the first to study the influence of this factor upon egg production was Thompson (12) who reported that February hatched pullets laid enough eggs during August, September and October to more than balance the decrease in production that occurred during November and December, when the pullets usually molted.

The first extensive investigation in regard to the influence of the date of hatch upon egg production was made by Goodale (4). He stated that the earlier the date of hatch the greater the number of eggs laid before March 1 (winter production). He also found that the date of hatch (March, April and May) had no definite relation to total egg production.

Buss (2) concluded from an experiment in which the pullets were hatched Feb. 22, April 20 and June 13 that there is little to be gained by hatching Leghorns as early as Feb. 22, and the indications were that the most satisfactory time in the vicinity of Wooster, Ohio, was about April 20.

Card (3) studied the production of Leghorns hatched at

1Project 51. Iowa Agricultural Experiment Station.
2The two preceding publications are:
various seasons of the year and reported that there was nothing in the data so far collected and analyzed to warrant the commercial production of any large number of pullets outside of the normal period in which poultrymen usually do most of their hatching.

Lewis and Thompson (11) found from their investigations that there was no economic advantage in hatching pullets during the late fall season.

Hays et al. (5) obtained a correlation of $-0.15 \pm 0.02$ between the hatching date and the age at which the first egg was laid. They also obtained a correlation coefficient of $-0.29 \pm 0.02$ between the hatching date and winter egg production for the entire flock. For their study they used the records obtained from 959 Rhode Island pullets compiled from 11 hatches from March 25 to June 3.

Kempster (6, 7) concluded from observations extending over a six-year period that the correlation of the date of hatch with sexual maturity was not consistent, and also that late hatching tended to reduce the age at which the first egg was laid. Three of the six years' data indicated that the later the pullets were hatched, the shorter was the time to bring them to maturity, while his correlation coefficients obtained for the records of 1919-20 and 1920-21 showed that the opposite was true. The data for one year, 1918-19, show practically no correlation, $0.07 \pm 0.06$. He concluded that sexual maturity was dependent to a considerable extent upon flock management.

The author (8) in a previous paper stated that there was a slight, though insignificant, correlation between the date of hatch and egg production in White Plymouth Rocks. He also stated that this correlation, $-0.19 \pm 0.08$, no doubt would be larger if the season of incubation had a greater range than three months.

Berry and Walker (1) gave the results from the records of Single Comb White Leghorns hatched during 10 months of the year. They reported that these data proved conclusively that at the New Mexico station, viewed from the standpoint of economy of production, March and April hatched chicks are superior to chicks hatched during any other month in the year. They also found that the April hatched group maintained good production during the months in which eggs were high priced. The early (March) hatched pullets also gave the largest net returns of all groups.

Upp and Thompson (13) found that the spring hatched pullets were older when they laid their first egg than were the birds hatched at other seasons. They also stated that there was little difference in the average egg production for the year between the winter and spring hatches, but the summer and fall hatched birds were decidedly poorer in production. In addi-
tion to this, the highest winter egg production was obtained from the birds hatched from April 7 to May 5. For the summer and fall hatched pullets, Upp and Thompson found that the later the chicks were hatched the lower was the egg production.

MATERIAL AND METHODS

In this investigation the association of the date of hatch with the average date of first egg, the average number of days to maturity, average winter, spring and annual egg production was studied. Data obtained from 684 Single Comb White Leghorns were used from records that covered a period of four years, 1924-25, 1925-26, 1926-27, 1927-28. The records for the four years were compiled, and the weeks in which the chicks were hatched were used as the independent variable. These results are presented graphically in fig. 1. The means with the probable errors and the standard deviations are presented in table I.

The date of hatch is the week in which the chicks were hatched. Maturity is the age of the pullet when she laid her first egg. Winter egg production is the number of eggs laid from the date of the first egg to Feb. 28, inclusive.

Spring egg production is the total number of eggs laid during March, April, May and June. This may also be regarded as rate of production, because it is during this period that most pullets produce the largest number of eggs in the shortest time. Rate has been variously calculated by different investigators. Some have used the highest single month's production record as an indication of rate, others have used the best two consecutive months of production, and still others have used the percentage of production during the winter, as a criterion of rate, designating above 50 percent as fast rate and below 50 percent as slow rate of production. In any case, however, the term rate has been, and is, chosen arbitrarily by all investigators. In this study, the term spring egg production is used, but rate might be used synonymously with it.

Total or annual egg production, as used in this investigation,
is the number of eggs produced in the 365 consecutive days from the date on which the first egg was laid.

**EXPERIMENTAL**

The data for four years were taken from the records of 684 Single Comb White Leghorn pullets. The frequency distribution of the date of hatch and of the number of individuals in each group is given in fig. 1.

**THE DATE OF HATCH COMPARED WITH THE DATE OF FIRST EGG**

Figure 2 illustrates very well that the month in which the pullets were hatched has a positive rectilinear association with the date on which the first egg was laid. The birds hatched in February, on an average, laid their first egg during the week of Sept. 3 to 10, and with each succeeding month that the birds were hatched the first egg was laid at a later date until for the birds hatched in June and July the average date of first egg was during the week of Dec. 5 to 11. This is very important because the date of first egg has a close association with winter and total egg production. It was shown in a previous publication by the author (10) that the later a pullet lays her first
egg the fewer eggs she will lay in the winter period and the fewer she will lay in a year's time. It was also shown that the best month for a bird to start her production period was in September, October, November or the first part of December. It is evident that pullets should be hatched at such a time that they will lay their first egg some time during these months. If such a procedure is followed, it will compensate for the maturity of the birds whether early or late in the particular strain of birds that the poultryman may have. If the majority of pullets lay their first egg later than Dec. 7, it would be advisable to incubate eggs from the same or similar stock earlier the following year in order to have the pullets lay at an earlier date. If this procedure is followed production should be improved. In the present investigation the birds hatched in March, April or May laid their first egg on an average during the period from Sept. 25 to Dec. 6, the optimum time for pullets to start laying as mentioned in a previous publication (10).

THE DATE OF HATCH COMPARED WITH THE AGE AT FIRST EGG IN DAYS

Figure 3 shows the association between the date of hatch and the age at first egg in days (sexual maturity). This graph shows a slight bimodal effect but the numbers included in the groups from Feb. 8 to March 14 are too small to warrant assum-
Fig. 3. Average age at first egg of birds hatched at different dates.

The actual number of days to sexual maturity is important. It has been shown by the author (9) in a previous bulletin, that the maximum number of eggs was produced by those birds which averaged from 180 to 200 days to maturity. From the data it can be assumed that the optimum number of days to maturity is closely approached, on an average, by those birds which were hatched in March, April, or June.

These results agree with those of Upp and Thompson (13), even though the sexual maturity of the birds in the present study was earlier and the range of the date of hatch was less. This short range included practically all months in which it might be assumed that the greatest profits would be obtained. These data support Kempster (7) in his conclusions that the date of hatching and its association with sexual maturity are dependent upon flock management, and that late hatching tends slightly to reduce the age at which the first egg is laid. The data of Hays (5) were also in agreement with these results.

The present data do not show as close an association of the date of hatch with the number of days to sexual maturity as other investigators found. This may be due to the fact that practically all the pullets matured within the optimum number
of days for early sexual maturity regardless of the date of hatch. The only exceptions to the above statement were the pullets hatched during the week of Feb. 16 to 22, and these birds were reared on a ration much lower in protein than that used for the others. The writer (8) in a previous publication showed that the pullets which reached sexual maturity in 140 to 220 days produced 50 or more eggs for the winter period. The pullets hatched between March 1 and May 25 produced 50 eggs or more for the winter period.

THE DATE OF HATCH COMPARED WITH WINTER EGG PRODUCTION

The data presented in fig. 4 indicate that there is a decided curvilinear association between the week in which the pullets were hatched and the number of eggs produced before March 1. The high point of production is reached by those birds that were hatched during the week of March 29 to April 5. These pullets laid an average of 78 eggs before March 1 of the following year. This number of eggs is decreased with each week of hatch after and preceding the week of March 29 to April 5. There is a gradual decrease of production for each subsequent week of hatch until the sum of 44 eggs is reached for the pul-

![Fig. 4. Average winter egg production of birds hatched at different dates.](image)
lets hatched during June and July. Furthermore, there was progressively less production for each week preceding March 29. The 27 birds hatched Feb. 8 to 15 were an exception to this, since they laid an average of 64 eggs, but this production cannot be regarded as being significant as there were too few birds included in this group.

Previous correlation studies have been interpreted as showing that the association of the date of hatch with the number of eggs laid before March 1 was rectilinear. Certain investigators have tried to fit a straight line to the data, whereas a much better fit might be obtained by a curved line. Such a statistical measure as a rectilinear correlation would, in this case, give an inaccurate idea of the association of these two factors, the correlation coefficient being markedly decreased.

The results found in this investigation agree substantially with the data of Kempster (6) and Upp and Thompson (12). In a correlation study made by Hays et al., (5) the date of hatch is correlated with winter egg production when rectilinear correlation analyses are employed. Therefore, the correlation obtained is probably much lower than the actual association of these two factors.

THE DATE OF HATCH COMPARED WITH SPRING EGG PRODUCTION

In fig. 5 there is a positive rectilinear association between the month in which the pullets were hatched and spring egg production. This suggests that the earlier a bird is hatched the fewer eggs she would produce during the following spring period.

These results are opposite to those of Upp and Thompson (12), who in a corresponding period from Feb. 12 to June 16, obtained a decreasing spring production from approximately 82.9 eggs for the February hatched pullets to 58.6 eggs for June 30 to July 28 hatched birds. On the other hand, the data in this study show an average of 78.5 eggs for those birds hatched during the week of Feb. 8 to 15. Production increased for practically each succeeding month in which the pullets were hatched until an average of 92.4 eggs was reached for the pullets hatched during the week of May 18 to 25.

In the present investigation the pullets hatched during March 30 to June 8 laid an average of more than 83 eggs per bird for the spring period. From March 30 to Feb. 7 there seems to be a steady decrease in the production of the birds for this period. This difference may be due to the smaller number of individuals in each group used by Upp and Thompson (12), to the difference in climate, the particular strain of Leghorns, or any combination of these factors.
THE DATE OF HATCH COMPARED WITH THE TOTAL ANNUAL EGG YIELD

The association of the week in which the pullets were hatched with the total annual egg yield seems to be of a curvilinear nature as shown in fig. 6. The greatest number of eggs was produced by those birds which were hatched during the week of March 29 to April 5. For the birds hatched previous to, and after this time, the production decreased, but the production of the birds hatched in the month preceding April was somewhat lower than each corresponding period in the ensuing months. The egg production decreased until it reached 200 eggs for those birds hatched the week of July 21 to 27. And in the preceding months it diminished until a sum of 162 eggs was reached for the birds hatched during the week of Feb. 8 to 15.

This curvilinear trend of the date of hatch with total egg production shows that there is an optimum time to hatch for the optimum egg yield which is shown by those birds hatched during the period of March 29 to approximately May 25.

These results agree with the data of Card (3) and of Kempster (6). The data disagree with Upp and Thompson (12) who obtained a negative rectilinear correlation, the largest number...
of eggs being laid by the pullets hatched in the early winter period (Nov. 17, Dec. 1 and Dec. 17), and with each corresponding period after this time the production decreased until an average of 110 eggs was produced by the birds hatched in the early fall. The results obtained by Card (3) Kempster (6) and the present data, on the contrary, show that maximum total egg production is reached by the Leghorn pullets hatched in April, and that this production decreased for each preceding and succeeding month that the birds were hatched within the range of the data. It is true that the present data are obtained from birds hatched over a period of five months only, but it agrees with the data of Card (3) which have a greater range. Card showed that the pullets hatched in April produced a total of 172 eggs and the production of the pullets hatched during the preceding or ensuing months decreased until it reached 113 eggs for the birds hatched in January, and to 121 eggs for the birds hatched in December.

It may be that the rectilinear association that Upp and Thompson (12) obtained in contrast to the curvilinear association by Card, Kempster and the present author was due either to the smaller number of individuals used in each group by Upp and Thompson (12), to the breeding or possibly to the warmer climate.
Where correlation coefficients have been used in previous investigations, the authors, including the writer (7), had presupposed rectilinearity, whereas the data were probably curvilinear where large enough numbers were used. This, of course, gives rise to a great variation in the coefficients of correlation found by various investigators, depending upon the number of individuals used and the particular segment of the population with which the investigator was working.

If this curvilinearity is true, then the optimum date of hatch in order to have pullets start their first year’s production at the best time would probably be March 16 to May 25. Rectilinear correlation for these two variables would show that the earlier a pullet was hatched, the more eggs she would produce. That is, if a bird was hatched in January she would produce more eggs than a bird hatched in February, and a bird hatched in February would lay more eggs than one hatched in March, and so on. This apparently does not hold true throughout the entire calendar year, first, because the work of several investigators contradicts this rectilinearity, and second because it would mean there would be a very great difference between the birds hatched in December, which would lay the fewest eggs, and the birds hatched in January which would lay the most eggs in a year’s time.

Table I gives the means with their probable errors and the standard deviations for the variables used (see p. 251).
LITERATURE CITED


