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Hatchability as Related to Seasons and Hour of Laying¹

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PROBLEMS in hatchability have been studied by a large number of workers including Pearl, Dunn, Hutt, Jull, Warren, Waters, Byerly and Dove as well as many others, reported in Jull's *Poultry Breeding*, 1932. Under uniform conditions of incubation, the greater proportion of evidence indicates that the genetic makeup of the female and of her mate largely determine the percentage of fertile eggs that will hatch. Malposition and a few lethal genes are known to increase embryonic mortality. Byerly, Knox and Jull (1934) express the opinion that the inheritance of hatchability must be determined by a very large number of genes.

Recently Dove (1935) and Waters (1935) have demonstrated that the lethal effects of malposition have probably been exaggerated. Both of these workers have shown that normal chicks assume these so-called abnormal positions as a phase of normal development between the eighteenth day and the hatching day. In view of this fact both workers conclude that many dead chicks that are found abnormally oriented in the egg have died at a particular stage in

embryological development not as a result of position in the egg but from other causes.

Examination of thousands of eggs that have failed to hatch at this Station reveals many embryos both living and dead that show no visible abnormalities. No other cause than lack of vigor can be assigned for this large proportion of embryos which never emerge from the shell. Data on the Massachusetts flock as well as from other workers indicate that inheritance plays a large part in determining the percentage of embryos that will hatch normally.

DATA AVAILABLE

Data are available on the hour of laying and the complete hatching record of Rhode Island Red females covering the years from 1916 to 1935. Hatching records for 1926 are omitted because dipping the eggs in an oily disinfectant apparently made the hatching records abnormal. The records include 985 hens and 1,557 pullets that laid a minimum of ten eggs during the 56-day hatching period. From 1916 to 1932 the eight weekly hatches occurred between March 25 and May 15. From 1933 to 1935 the eight hatches took place three weeks earlier giving four hatches in March and four in April.

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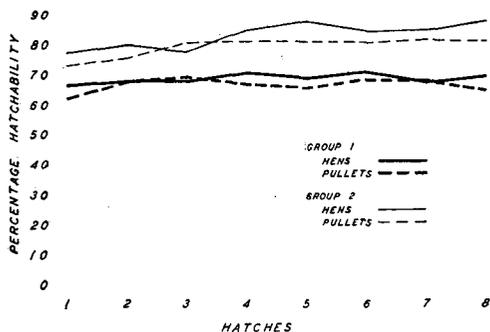


CHART 1. Relation of hatching date to hatchability.

The incubators used in the earlier period were lamp machines through 1929. A double deck water heated machine was used from 1929 to 1932. In 1932 the water heated machine was supplemented by a compartment electric machine. Since 1933 an electric cabinet machine has been used exclusively. The electric cabinet machine has proved much more efficient than any of the machines previously used. Incubation conditions have always been far from ideal because of low cellar temperatures.

OBJECTS OF STUDY

There are two primary objects of this study: First, the relation of season to hatchability of fertile eggs; Second, to determine the possible relationship between the hour of laying and fertility of eggs, early embryonic death rate, late embryonic

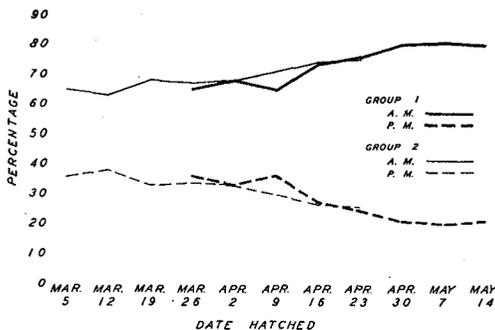


CHART 2. Proportion of forenoon and afternoon eggs laid.

death rate and the percentage of fertile eggs that hatched from hens and from pullets.

RESULTS OF INVESTIGATION

For purposes of study the hatches obtained from 1916 through 1932 are included in group I and the hatches from 1933 to 1935 as group II. All females used for breeding in their first laying year are classed as pullets and all yearling or older females as hens. Eggs used for each hatch were laid during a seven-day period previous to incubation.

1. Hatching Date and Hatchability

Chart 1 presents the percentages of fertile eggs that hatched in the eight weekly hatches. In group I both hens and pullets

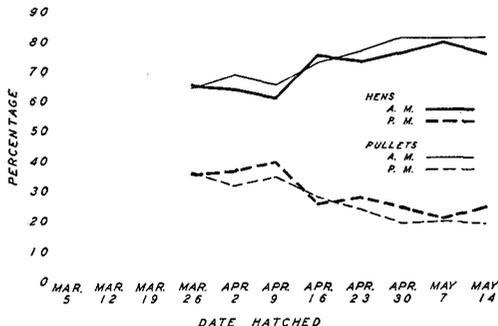


CHART 3. Proportion of forenoon and afternoon eggs laid by hens and by pullets, group 1, 1932.

showed a slight increase in hatchability as the season advanced. This increase was slightly more pronounced with hens. When group II is considered there was a somewhat greater increase in hatchability as the season advanced. Hens gave a marked improvement in hatchability through the season while pullets showed no change after the first two hatches. The charts are based on 12,686 fertile eggs laid by hens and 21,404 fertile eggs laid by pullets in group I and on 3,842 fertile eggs from hens and 7,208 fertile eggs from pullets in group II. These rather extensive data indicate that eggs from hens were more affected by seasonal

conditions than were pullet eggs and that under the conditions of incubation used late hatching did increase hatchability.

2. Proportion of Forenoon and Afternoon Eggs

Before undertaking the study of the relation of hour of laying to fertility, embryonic mortality and hatchability it is desirable to ascertain the proportion of forenoon and afternoon eggs that were produced by hens and by pullets. All eggs laid up to 12 noon were classed as forenoon eggs and those laid after 12 noon we considered afternoon eggs.

The percentages of forenoon and afternoon eggs were recorded for each setting.

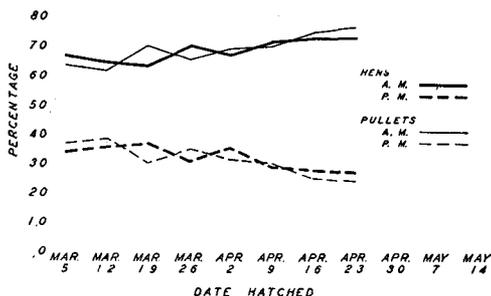


CHART 4. Proportion of forenoon and afternoon eggs laid by hens and by pullets, group 2, 1933.

Chart 2 illustrates the changes in proportions of morning and afternoon eggs as the season advanced. When the days were short in February only about 65 percent of the daily eggs were laid by noon. This was followed by a linear increase in the proportion of morning eggs up to early April. The rate of increase in the proportion of morning eggs was the same in both groups.

The proportions of morning and afternoon eggs set from hens and from pullets may be compared in charts 3 and 4. Chart 3 shows that pullets in group I laid a slightly greater proportion of morning eggs compared with hens through the hatching season. The rate of change in proportions of morning and afternoon eggs with advance

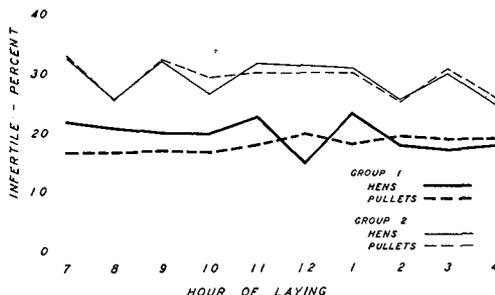


CHART 5. Hour of laying and percentage of infertile eggs.

of the season was the same in hens and pullets.

The somewhat greater portion of morning eggs laid by pullets in group I is very little in evidence in group II. Chart 4 shows that hens and pullets lay about the same proportions of morning and afternoon eggs from early February to late April. Between these dates there is a linear increase in the proportion of morning eggs.

In view of the data presented in charts 2, 3 and 4, the more rapid increase in the hatchability of hens compared with pullets with advance of season shown in chart 1, cannot be explained on the basis of different proportions of morning and afternoon eggs laid by hens compared with pullets.

3. Hour of Laying and Infertility

Chart 5 presents the percentage of infertile eggs laid at ten different hours during the day. Infertility was about 10 percent

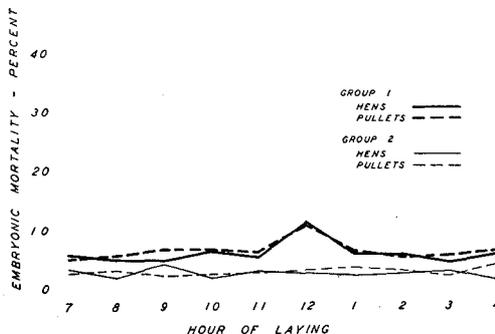


CHART 6. Hour of laying and embryonic mortality to five days.

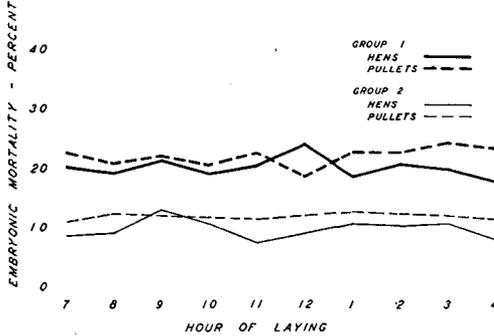


CHART 7. Hour of laying and late embryonic mortality.

higher for both hens and pullets in group II showing that cold winter weather is inimical to high fertility under the housing conditions used. The data show that both hens and pullets of group II had almost identical infertility. There were minor fluctuations from hour to hour but there was no significant change in infertility through the day. Eggs laid by the hens of group I in the forenoon gave somewhat higher infertility than pullet eggs laid during the same hours. Pullet infertility in group I increased very slightly in the eggs laid after ten o'clock. In general, the data show no very significant relationship between hour of laying and infertility in either hatching group.

4. Hour of Laying and Early Embryonic Mortality

Embryos that died by the fifth day of incubation are classed as early deaths in this

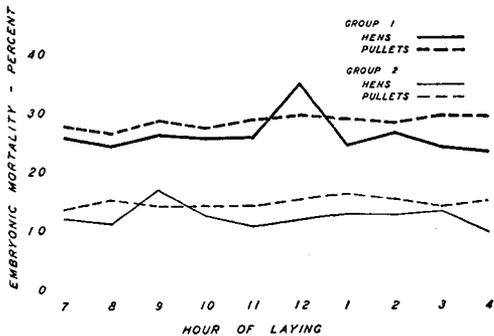


CHART 8. Total embryonic mortality.

study. Possible relations between hour of laying and early embryonic mortality are depicted by chart 6. All percentages are based on the total eggs set. Mortality was much higher in group I probably due largely to less efficient incubators used in the earlier years. In group I eggs laid by pullets during the morning hours gave a slightly greater mortality than hen eggs laid during the afternoon. No explanation is available to account for the high mortality for eggs laid during the noon hour in the late hatch group. With more efficient incubation to produce the early hatch group, there was essentially no relation between the hour of laying and embryonic mortality. Pullets and hens also behave in the same general way.

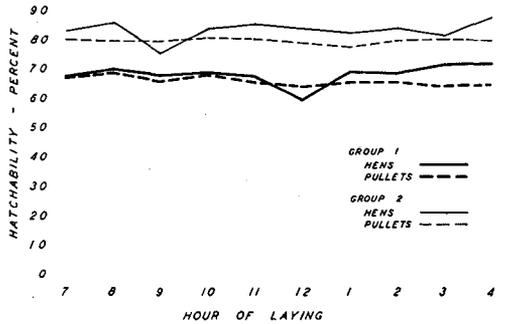


CHART 9. Hour of laying and hatchability of fertile eggs.

It seems probable that under an efficient system of incubation that the hour when eggs are laid does not affect early embryonic mortality.

5. Hour of Laying and Late Embryonic Mortality

All embryos that died after the fifth day of incubation and all those that failed to emerge from the shell are lumped together in the late mortality class. Chart 7 shows that pullets gave a somewhat greater embryonic mortality than hens in both groups. The data showed no significant relation between hour of laying and late embryonic

mortality in either hens or pullets. These results are not in agreement with those of Hutt and Pilkey (1930) who found that late mortality in embryos was higher in afternoon eggs than in eggs laid before 9 a.m. These results do agree with those of Nicolaides (1933) even though his data are calculated on the individual hen basis.

6. *Hour of Laying and Total Embryonic Mortality*

Chart 8 presents the total embryonic mortality for the entire incubation period. In group I there is considerable fluctuation between hours and pullets show a greater mortality than hens. There is, however, no evidence that hour of laying affects embryonic mortality. In group II mortality is very constant from hour to hour and about 10 percent lower than in group I. Hens and pullets also gave about the same mortality rates. These data clearly show the effects of poor incubation on embryonic mortality. All results in these studies indicate that hour of laying has no effect upon embryo mortality.

7. *Hour of Laying and Hatchability of Fertile Eggs*

Chart 9 presents the summarized data on hatchability of fertile eggs on the basis of hour of laying. Hen mothers in group I showed an insignificantly higher hatchability in the afternoon eggs. Pullets showed no relation between hour of laying and hatchability. In group II hens gave a significantly higher hatchability than pullets but no significant relation between hour of laying and hatchability. Pullets gave a very constant hatchability from hour to hour.

SUMMARY

Hatching records covering twenty years are reported considering the relation between the hour that the eggs were laid and infertility, early embryonic mortality, late embryonic mortality, total embryonic mortality and percentage of fertile eggs that hatched. The percentages of fertile eggs hatching through the season is also reported.

1. Hatchability increased through the hatching season for hens but not for pullets.

2. The proportions of forenoon and afternoon eggs laid through the hatching season did not differ from hens and pullets.

3. Hour of laying does not affect infertility.

4. Hour of laying had little or no effect on early embryonic mortality.

5. Hour of laying did not modify late embryonic mortality.

6. Total embryonic mortality was independent of hour of laying.

7. Hatchability of fertile eggs was not affected by hour of laying.

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