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The Relation
of Feather Pigmentation to
Intensity of Laying in
Rhode Island Reds

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Deep rich plumage color and high winter laying intensity in Rhode Island Reds are desirable characters which can be influenced by breeding. This investigation was undertaken to determine to what extent both of these characters can be developed simultaneously by the breeder.

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THE RELATION OF FEATHER PIGMENTATION TO INTENSITY OF LAYING IN RHODE ISLAND REDS

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INTRODUCTION

Experience of exhibition breeders of Rhode Island Reds indicates that in order to develop the deep rich color now demanded in both sexes a considerable period of time is required before sexual maturity is attained. In other words, if pullets and cockerels become sexually mature at six or seven months they are likely to show a lighter shade of plumage than the Standard requires.

In the spring of 1915, thirty-two high-class exhibition Rhode Island Red pullets were hatched and reared at the Massachusetts Agricultural Experiment Station along with the birds being bred for high fecundity. These thirty-two pullets had an average age of 291 days when they laid their first egg while eighty-nine production-bred birds hatched and reared with them showed an average age of 253 days when they began to lay.

In the spring of 1929 a group of thirty-nine excellent exhibition pullets was hatched and reared with chicks bred for egg production. The average age at first egg was 291 days for the exhibition pullets and 197 days for 507 production pullets.

A tendency for the production-bred stock to be deficient in color was observable as early as 1915 while in 1929 practically all stock was deficient in color and some approached buff and others carried pronounced black mottling. Smut in under-color was not common.

Exhibition stock studied in 1915 was less deeply pigmented than the present-day Rhode Island Red. The stock hatched in 1929 approached the bay shade of Ridgway (1912). A rather large proportion of the birds carried smut in under-color as well. Under-color varied in shade, but the fluff was far more intensely pigmented than in the production-bred birds.

Martin (1929) has definitely shown with Barred Plymouth Rocks that exhibition color is associated with slow maturity and his data indicate a probable correlation between exhibition plumage color and low intensity.

There is definite need for experimental evidence on the relation of degree of pigmentation in Rhode Island Reds to intensity of laying. Winter intensity has been shown by Hays and Sanborn (1927) to be rather intimately associated with annual production. The Standard of Perfection (1930) calls for rich red plumage color in both males and females, making dark plumage color of economic importance. It would seem desirable, therefore, from the breeder's standpoint to combine exhibition plumage color with high intensity.

The experiment reported below began with two foundation groups of birds hatched in 1927. The first group consisted of forty-eight pullets selected for very light adult plumage color. The second group was made up of forty-nine pullets selected for dark plumage color. Both groups came from the flock that had been bred for high fecundity since 1913. Generations two, three and four were hatched the following years. The selection of breeders each season was on the basis of very light and very dark plumage. All birds were pedigreed, females were trap-nested for a full year, and both male and female progeny were described for plumage color at the age of about six months.

Plan of Matings

In the spring of 1928, four unrelated females from the light-colored foundation were mated to an unrelated, light-colored cockerel. From the dark-colored foundation, two pairs of sisters unrelated and a third unrelated pullet were all mated to a selected unrelated dark-colored cockerel.

In 1929 the breeding stock in the light line consisted of three full sisters mated to their half-brother. The breeders in the dark line were two pairs of half-sisters mated to their half-brothers.

The 1930 breeding stock in the light line consisted of two half-sisters mated first to their uncle and later to the male used in this line in 1929. The dark group contained two full-sisters mated to their uncle.

PLUMAGE COLOR IN THE DIFFERENT GENERATIONS

1928 Breeders

In the light-colored line, offspring were retained from four females with the following color description:

H993—Orange hackle, medium red surface color except for a dark salmon breast, light under-color free from smut.

H1076—Medium red hackle, medium red surface except for a dark salmon breast, light under-color with a slight amount of smut.

H1106—Orange hackle, very light red surface color, salmon breast, very light under-color free from smut.

H1270—Orange hackle, medium red surface except for dark salmon breast, light under-color free from smut.

Male H3515—Orange hackle, very light red surface color and under-color, no smut.

The dark-colored line came from five females and a male described as follows:

H1154—Orange hackle, medium red surface except light in breast, light under-color with smut.

H1156 (full sister to H1154)—Orange, black-ticked hackle; dark red surface color; rather light under-color with smut.

H1293—Orange, black-ticked hackle; dark red surface color mottled with black; light under-color with smut.

H1459—Medium red surface color and medium under-color with only a trace of smut.

H1460 (sister to H1459)—Orange hackle, medium red surface color except for light breast, light under-color free from smut.

Male H3164—Dark red hackle, dark red surface color, under-color somewhat light but free from smut.

1929 Breeders

In the light-colored line the plumage color is described as follows:

I733—Light red surface color, light under-color, free from smut.

I1226—Medium surface color, medium under-color, free from smut.

I1782—Light red surface color, light under-color, free from smut.

Male I1206—Very light surface color and very light under-color without smut.

In the dark-colored line the descriptions follow:

I1230—Medium surface color, very light under-color, free from smut.

I1261—Medium dark surface color, light under-color and no smut.

I1845—Dark surface color, medium under-color, no smut.

I2383—Near standard color, medium under-color, free from smut.

Male I389—Near standard surface color, medium under-color and no smut.

1929 Offspring

The males and females hatched in the two lines in 1929 may be roughly grouped for surface plumage color as follows:

TABLE 1.—PLUMAGE COLOR.

Color	Light Line		Dark Line	
	Males	Females	Males	Females
Very light.....	2	2	0	0
Light.....	24	20	11	0
Medium.....	3	6	27	7
Dark.....	0	0	4	14
Standard.....	0	0	0	2
Total.....	29	28	42	23

The tendency of the males to appear in a lighter plumage class than their sisters is noticeable in the dark line, while there is no significant difference in grouping of males and females in the light line.

1930 Breeders

Two hens were used as breeders in the light line in 1930. They were described as follows:

J1503—Light orange, black-ticked hackle; light red surface; light under-color and no smut.

J2681—Light orange, black-ticked hackle; medium light red surface color; medium under-color, somewhat mottled but no smut.

Male I246—Very light in color.

Male I1206—Very light surface color, very light under-color, no smut.

In the dark line only one female was used as a breeder. She is described as follows:

J544—Orange, black-ticked hackle; dark red surface; medium under-color and no smut.

Male H3164—Dark black-ticked hackle, medium dark red surface, medium under-color, no smut.

1930 Offspring

Using the same grouping for color as was applied in 1929, the 1930 progeny were classed as follows with respect to plumage color:

TABLE 2.—PLUMAGE COLOR.

Color	Light Line		Dark Line	
	Males	Females	Males	Females
Very light.....	1	0	0	0
Light.....	4	6	0	0
Medium.....	2	5	0	6
Dark.....	0	0	1	3
Standard.....	0	0	0	0
Total.....	7	11	1	9

The number of offspring in the last generation is very small. This is due to decreased egg production reducing the number of breeding females selected,

probably intensified by inbreeding. There is still considerable overlapping in the two lines in the medium color-group, and the tendency for males to show lighter plumage color than their sisters still persists.

TABLE 3.—MEAN HATCHABILITY AND ANNUAL PRODUCTION OF THREE GENERATIONS.

	Mean Hatchability, Per Cent		Annual Egg Production	
	Light Line	Dark Line	Light Line	Dark Line
1928.....	58.5	69.8	229	218
1929.....	78.7	73.0	197	206
1930.....	83.0	50.0	197	180

The foundation group of light-colored birds includes 29 individuals with complete annual egg records. The mean for this group is 188 eggs, while the foundation dark-colored group including 33 birds averaged 184 eggs. This difference of four eggs is not statistically significant.

Hatchability of breeding females varied widely and not consistently in the three seasons reported.

Annual egg production showed a significant decrease on successive generations as might be anticipated as a concomitant of inbreeding.

PLUMAGE COLOR AND WINTER INTENSITY

The foundation females in the light and dark lines may be roughly classed into five groups with respect to surface plumage color of back. The accompanying table gives the number of individual birds in each group and the mean winter clutch size of the group. It will be observed that the light and dark lines overlap in the medium group and that the mean clutch size in this group in the two lines is essentially the same. A consistent decrease in winter clutch size with increased color is observable in all classes with a significant number of birds. The fact should be mentioned in this connection that the two individuals with the extremely large clutch size of 10.5 and 10.6 respectively, are in the very light group. One individual of the dark line in the medium group showed a clutch size of 9.3.

Foundation Females—1927

TABLE 4.—SURFACE PLUMAGE COLOR OF BACK AND WINTER CLUTCH SIZE.

Color	Light Line		Dark Line	
	Number	Clutch Size	Number	Clutch Size
Very light.....	29	3.73	0	.....
Light.....	13	2.75	1	1.7
Medium.....	6	3.57	23	3.46
Dark.....	0	.....	19	3.19
Standard.....	0	.....	4	2.58
Total.....	48		47	

1928 Generation

Complete records on plumage color of the progeny hatched in 1928 are not available for study. Consequently, the relation of plumage color and clutch size cannot be considered.

1929 Generation

A total of 55 pullets is available in the 1929 generation. These are classified into five color groups and the mean clutch size of the groups recorded in Table 5.

TABLE 5.—PLUMAGE COLOR AND CLUTCH SIZE.

Color	Light Line		Dark Line	
	Number	Clutch Size	Number	Clutch Size
Very light.....	2	3.75	0	.....
Light.....	24	3.00	0	.....
Medium.....	6	2.71	12	3.03
Dark.....	0	.....	9	2.44
Standard.....	0	.....	2	2.25
Total.....	32		23	

These data are consistent, for an increase in degree of plumage color is regularly followed by a decrease in clutch size.

1930 Generation

Table 6 shows the same consistent relationship between clutch size and degree of pigmentation as in previous generations. There is some evidence of increased intensity in the dark line, and there is a tendency for medium shade birds in the dark line to excel medium shade birds in the light line, especially during the last two generations of this experiment.

TABLE 6.—PLUMAGE COLOR AND CLUTCH SIZE.

Color	Light Line		Dark Line	
	Number	Clutch Size	Number	Clutch Size
Very light.....	0	.....	0	.....
Light.....	8	5.44	0	.....
Medium.....	3	2.87	7	3.79
Dark.....	0	.....	1	2.40
Standard.....	0	.....	0	.....
Total.....	11		8	

Table 7 shows that the mean age at sexual maturity was slightly greater in the dark line in all generations after the first. Mean winter clutch size of the dark line was also below the light line in all generations. In mean winter production the light line surpassed in all generations, except the last. In general the data show some superiority of the light line over the dark line in winter intensity. The superiority of the light line over the dark line in annual egg production is not statistically significant in any generation and the light line cannot be considered superior from the standpoint of fecundity.

TABLE 7.—MEAN AGE AT FIRST EGG, MEAN WINTER CLUTCH, MEAN WINTER PRODUCTION, AND MEAN ANNUAL PRODUCTION IN TWO LINES THROUGH FOUR GENERATIONS.

Generation	Age at First Egg	Winter Clutch	Winter Production	Annual Production
Light Line				
1.....	183.8 ± 2.64	3.7 ± .30	88.8 ± 2.53	188.1 ± 5.46
2.....	193.7 ± 2.83	3.8 ± .18	93.4 ± 2.78	228.6 ± 4.88
3.....	186.7 ± 2.68	3.3 ± .18	86.1 ± 3.22	197.3 ± 4.61
4.....	189.2 ± 5.26	4.3 ± .16	88.8 ± 6.36	196.8 ± 6.04
Dark Line				
1.....	179.9 ± 2.09	3.4 ± .19	82.8 ± 2.87	184.2 ± 5.17
2.....	198.0 ± 2.55	3.7 ± .13	84.3 ± 2.69	217.9 ± 5.36
3.....	194.2 ± 3.48	2.7 ± .16	73.9 ± 4.14	206.4 ± 8.26
4.....	198.0 ± 4.92	3.1 ± .29	92.2 ± 3.36	180.2 ± 5.74

GENETIC RELATION OF WINTER INTENSITY AND RHODE ISLAND RED COLOR

Since exhibition Rhode Island Reds are slower maturing than production-bred birds, it is possible that sexual maturity checks the intensification of pigment. The difficulty of measuring such a physiological effect is apparent, however. There is also evidence that early sexual maturity does not always prevent the development of the deep shade of pigment desired. The genetically late-maturing birds in the light group showed even a smaller mean clutch size than the late-maturing birds in the dark group. The number of birds concerned in both lines, however, is small.

The eight smutty birds in the original foundation had a mean clutch size of 3.1 which does not indicate that gene E, responsible for smut in under-color, is linked with gene I for medium clutch size.

Extreme clutch sizes of four or more were equally numerous in both the light and the dark lines of the foundation stock.

Since the population used carried but a very small proportion of genetically late-maturing birds, it is not possible to adequately study the relation of surface color to late sexual maturity. A group of 31 exhibition pullets hatched and reared in 1929 consisted of 30 genetically late and 1 genetically early. The single early individual had a clutch size of 2.4 and there were three birds in the late group with clutch sizes equal to or greater than this. The mean winter clutch size of the 30 late-maturing birds was 1.4. These data suggest that deeply colored birds are likely to be deficient in winter clutch size.

In general, the data obtained in this experiment show that large clutch size is a little less common in the dark birds but that the birds with medium shades of red average high in clutch size in both the light and the dark lines. It seems probable, therefore, that the genetic make-up necessary for very dark plumage color is such that a long developmental period previous to sexual maturity is necessary. Since early sexual maturity is rather intimately correlated with large winter clutch size, a large proportion of deeply colored birds might be expected to exhibit low intensity. In view of this fact, it would seem to be a laborious process to establish uniform deep pigmentation and high intensity in a flock, but a medium shade of red should be maintained without difficulty. Care should be taken to select as breeders only birds homozygous for gene B and at the same time showing a winter clutch mean of three or more.

SUMMARY

Light and dark-colored lines of Rhode Island Reds were carried through four generations to discover possible relations between intensity of laying and degree of feather pigmentation.

Age at sexual maturity was slightly greater in the dark line.

Winter clutch size was smaller in the dark line in all generations.

The gene for smut appears to be independent of the genes for high winter intensity.

The data show indirectly that deep plumage color occurs generally in slow-maturing birds and that a developmental period greater than 215 days from hatching to sexual maturity is required for the development of the deep shade of pigment now demanded in exhibition Rhode Island Reds.

There is evidence that a medium shade of red is often accompanied by high winter intensity.

Overlapping in shade of color frequently occurred between the darker individuals of the light line and the lighter individuals of the dark line.

Annual egg production was not significantly different in the two lines in any generation.

Results of this experiment indicate that a medium shade of red is more typical of a Rhode Island Red flock bred for high fecundity than a very dark or a very light shade.

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