

COLOR MARKINGS IN RHODE ISLAND RED CHICKS AS RELATED TO SEX AND ADULT COLOR¹

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INTRODUCTION

Rhode Island Red chicks have long been known to vary widely in the color of their down. Warren² made a study of the inheritance of down color in Rhode Island Red chicks and its relation to adult plumage color and pointed out important variations in down color. Although he was not concerned with possible relations between down color and sex, he noted that striped chicks were preponderantly females.

Byerly and Quinn³ made a study of down color in Rhode Island Red chicks in relation to sex. They studied 1,102 chicks and well-developed embryos from production-bred stock and 663 chicks from a standard-bred flock. They classified chicks for black pigment spots on the head or stripes on the back, but they made no reference to brown pigmented areas on head or back. Their data showed that 47.5 percent of the chicks examined were spotted or striped and that 84.9 percent of the spotted or striped chicks were females and 77.8 percent of the nonspotted were males. Of the striped chicks 93.6 percent were females. In standard-bred chicks 42.1 percent were either spotted or striped. Byerly and Quinn concluded that spotting and striping are widely distributed in Rhode Island Red chicks.

Quinn and Byerly⁴ made a further study of spotting and striping in Rhode Island Red and New Hampshire chicks exhibited at the Northeastern Poultry Producers Exposition in 1936. These chicks represented groups selected for uniformity in down color. Of a total of 650 chicks from 26 different entries, 24.9 percent of the Rhode Island Reds and 13.3 percent of the New Hampshires showed some melanic pigment. The sex was determined on five lots of chicks from each breed and in this composite sample only 19.4 percent showed any melanic pigment. A sex ratio of 142 males to 100 females was observed. The percentage of females in the spotted chicks was 78.8. New Hampshire chicks were freer from melanic pigment than Rhode Island Reds both in selected and unselected samples.

EXPERIMENTAL METHODS

Color markings were recorded for 8,713 Rhode Island Red chicks as they were taken from the incubator in 1937, 1938, and 1939. Most of these chicks were bred for high fecundity, but a small number bred for exhibition quality were included each year. Distinction was

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² WARREN, D. C. THE INHERITANCE OF RHODE ISLAND RED CHICK DOWN-COLOR VARIATIONS AND THEIR RELATION TO COLOR VARIATIONS IN ADULT PLUMAGE. *Jour. Agr. Res.* 39: 781-794, illus. 1929.

³ BYERLY, T. C., and QUINN, J. P. SEXUAL DIMORPHISM IN SINGLE COMB RHODE ISLAND RED DOWN COLOR. *Jour. Hered.* 27: 319-322, illus. 1936.

⁴ QUINN, J. P., and BYERLY, T. C. SPOTTING AND STRIPING IN EXHIBITION CLASSES OF RHODE ISLAND RED AND NEW HAMPSHIRE BABY CHICKS. *Poultry Sci.* 16: 422-425. 1937.

made between brown and black pigment areas, and the location of the pigmented area was indicated. No attempt was made to breed for or against spotting and striping so that the data actually represent an unselected population of pedigreed chicks. Adult color was taken at 6 months of age on part of the birds and the color classes used represent the general surface color.

DOWN COLOR OF CHICKS WHEN HATCHED

The down color of the chicks according to sex is recorded in table 1.

Table 1 shows that in the male chicks 89.84 percent had no color markings; about 10 percent had either black or brown spots or stripes on the head; about 0.2 percent had black on the neck, 0.09 percent had brown on the neck; and 0.38 percent had black on the back as compared with 0.16 percent with brown on the back.

Among the female chicks 55.86 percent had solid down color and 44.14 percent had some type of spotting or striping as compared with about 10 percent of marked chicks among the males. In the total population of 8,713 chicks the probability of any one chick being a marked female was only 0.2159 and the probability of a marked chick being female was 0.806. The data show further that female chicks are much more likely to have pigment stripes on neck and back, as Warren⁵ has pointed out.

TABLE 1.—Color markings of 8,713 male and female chicks when hatched

Color marking	Males		Females	
	Number	Percent	Number	Percent
None.....	3,997	89.84	2,382	55.86
Black head.....	198	4.45	1,175	27.56
Brown head.....	250	5.62	703	16.49
Black neck.....	9	.20	55	1.29
Brown neck.....	4	.09	19	.45
Black back.....	17	.38	106	2.49
Brown back.....	7	.16	56	1.31
Chicks observed.....	14,449		14,264	

¹ Several chicks appear more than once because pigmentation occurred in more than 1 area.

DISTRIBUTION OF PIGMENT IN BLACK AND BROWN PIGMENTED CHICKS

A comparison of black and brown pigmented chicks of the same sex is shown in table 2 for the 2,325 pigmented chicks.

TABLE 2.—The relation of sex to distribution of color markings in black and brown pigmented chicks¹

Body part	Black pigmentation				Brown pigmentation			
	Male		Female		Male		Female	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Head only.....	176	88.44	1,024	87.22	242	96.03	633	90.43
Neck only.....	0	0	0	0	1	.40	0	0
Back only.....	2	1.01	3	.26	1	.40	1	.14
Head and neck.....	6	3.02	47	4.00	3	1.19	17	2.43
Head and back.....	13	6.53	93	7.92	5	1.98	47	6.71
Head, neck, and back.....	2	1.01	7	.60	0	0	2	.29
Total.....	199		1,174		252		700	

¹ 9 chicks recorded as having black in one part of the body and brown in another are omitted

⁵ See footnote 2.

When black pigment appeared in the individual there was no sex difference in its distribution. About 88 percent of males and 87 percent of females exhibited their black pigment on the head. Head and back showing black pigment in the shape of a head spot and a stripe on the back was next in importance and equally prevalent in the males and females that carried down pigmentation. Black pigment occurring as a stripe from the head along the neck was of considerable importance and probably about as frequent in males as in females in pigmented individuals. Black pigment did not appear on the neck alone; it did sometimes appear on the back alone. About 1 percent of black-pigmented chicks showed the black on head, neck, and back simultaneously.

Brown head spots were more prevalent in males than were black head spots. Brown on head and back was three times as prevalent in females as in males. Brown stripe on head and neck was more prevalent in the females. Brown pigment seldom appeared on the neck or back alone and very seldom on head, neck, and back simultaneously.

The data in table 2 indicate that black pigment spots and stripes were more common in the population studied than were brown pigmented areas. There is further evidence that some sex differences may occur in the distribution of brown pigment.

DISTRIBUTION OF COLOR MARKINGS OF CHICKS IN THE TOTAL POPULATION

A study was next made of the distribution of black and brown pigment without regard to sex in those chicks that carried pigmented spots or stripes at hatching. Table 3 records the combined data on 2,325 chicks.

TABLE 3.—Distribution of color markings of 2,325 newly hatched black and brown pigmented chicks of both sexes¹

Body part	Black pigmentation			Brown pigmentation		
	Chicks	Proportion of all chicks	Proportion of males	Chicks	Proportion of all chicks	Proportion of males
Head only.....	Number 1,200	Percent 13.77	Percent 14.67	Number 875	Percent 10.04	Percent 27.66
Neck only.....	0	0		1	.01	100.00
Back only.....	5	.06	40.00	2	.02	50.00
Head and neck.....	53	.61	11.32	20	.23	15.00
Head and back.....	106	1.22	12.26	52	.60	9.62
Head, neck, and back.....	9	.10	22.22	2	.02	0
Total.....	1,373	15.76	14.49	952	10.93	26.47

¹ 9 chicks recorded as having black in one part of the body and brown in another are omitted.

Of the chicks that showed black on the head only 14.67 percent were males, indicating that about 85 percent of the chicks with black pigment on the head were females, an observation which agrees closely with the findings of Byerly and Quinn.⁶ When the head spot was brown 27.66 percent of the chicks were males. The appearance of black spots or stripes on head, neck, or back, or various combinations of these areas, showed about the same relation to sex. When the

⁶ See footnote 3.

pigment was brown it generally appeared on the head and was somewhat less closely associated with sex. Chicks marked with black represented 15.76 percent of all chicks, and those marked with brown represented 10.93 percent of all chicks. There were, therefore, 26.69 percent of all chicks that showed some color markings. From the total of 8,713 chicks there were only 26.69 percent whose down pigmentation could be used as a guide in separating sex. Considering the marked chicks only, 14.49 percent of those marked with black were males and 26.47 percent of those marked with brown were males. When all chicks marked with black were combined with all marked with brown, 19.40 percent were found to be males and 80.60 percent females. As a practical means of separating sexes, down spots and stripes are of little value.

RELATION OF DOWN COLOR MARKINGS TO ADULT COLOR

An attempt was made to discover any relations that might exist between black and brown down color markings and general adult plumage color. For this purpose it was considered advisable to classify the birds at 6 months of age for general color of surface plumage rather than for color in different body regions. Adult plumage color was grouped into 5 general classes as shown in table 4 and male and females were considered separately and combined. Adult colors were recorded during the last 2 years of the study on 1,295 males and on 2,493 females. The data are summarized in table 4.

TABLE 4.—Color markings of chicks at hatching as related to adult plumage color and to sex, 1938 and 1939

Sex and adult color	Adults which, as chicks, were—						Total	
	Nonmarked		Black-marked		Brown-marked			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Males:								
Very light red....	21	1.73	0	0	0	0	21	1.62
Light red.....	684	56.39	20	37.04	13	46.43	717	55.37
Medium red.....	341	28.11	17	31.48	11	39.29	369	28.49
Dark or stand- ard red.....	125	10.31	16	29.63	3	10.71	144	11.12
Black mottled....	42	3.46	1	1.85	1	3.57	44	3.40
Total.....	1,213		54		28		1,295	
Females:								
Very light red....	76	5.13	34	4.70	25	8.65	135	5.42
Light red.....	784	52.94	312	43.15	153	52.94	1,249	50.10
Medium red.....	451	30.45	233	32.23	92	31.83	776	31.13
Dark or stand- ard red.....	122	8.24	128	17.70	9	3.11	259	10.39
Black mottled....	48	3.24	16	2.21	10	3.46	74	2.97
Total.....	1,481		723		289		2,493	
Both sexes:								
Very light red....	97	3.60	34	4.38	25	7.89	156	4.12
Light red.....	1,468	54.49	332	42.73	166	52.37	1,966	51.90
Medium red.....	792	29.40	250	32.18	103	32.49	1,145	30.23
Dark or stand- ard red.....	247	9.17	144	18.53	12	3.79	403	10.64
Black mottled....	90	3.34	17	2.19	11	3.47	118	3.12
Total.....	2,694		777		317		3,788	

Of the 1,213 males that had no pigment spots when hatched, 56.39 percent were classed as light red in adult plumage and 28.11

percent as medium red. Slightly over 10 percent approached the dark or standard red in adult color, and 1.73 percent were very light red. Black mottling appeared in 3.46 percent of the nonmarked males when they developed their adult plumage.

The small group of male chicks that had some black markings exhibited a somewhat darker adult plumage than was observed in nonmarked chicks. About 61 percent of these black-marked chicks showed medium or dark adult plumage color. Only 37 percent of these males marked with black were recorded as light red in adult plumage and none as very light red. Black mottling was less common also in the black-marked males.

A very small number of male chicks had brown spots or stripes. There was some evidence that brown spotting or striping was associated with light adult plumage color. The total male population showed light red and medium red as the prevailing adult color.

Female chicks that were not marked showed a higher percentage of very light red individuals than the males and a somewhat smaller percentage of dark red. The incidence of black mottling was almost the same in both sexes. The data suggest in general that the prevailing shade of adult color was slightly lighter in females than in males on a relative basis.

Black-marked female chicks developed a little darker adult color than did the nonmarked females. The percentage of dark-red birds among the black-marked females was twice as large as that among the nonmarked females. The percentage of light-red individuals was smaller in the black-marked group and black mottling was somewhat less frequent.

Brown-marked female chicks tended to run a little lighter in adult plumage than nonmarked or black-marked chicks. There was a very small percentage with dark plumage color. Black mottling was equally frequent in brown-marked and nonmarked chicks. Adult males were slightly darker than females. In both sexes the appearance of black pigment in down appears to be associated with darker shades of general plumage color in adults. Differences observed in the adult color of black-marked chicks as compared with nonmarked or brown-marked chicks are not outstanding but do appear to exist.

In the total population light-red adult color prevails in the three kinds of chicks. There again appears to be an advantage from the standpoint of darker adult color and freedom from mottling in selecting chicks with black pigmented areas. In a flock bred for high fecundity where the general plumage color tends to run light, something may be gained in plumage color by selecting chicks that show black pigment spots or stripes.

SUMMARY AND CONCLUSION

A study of 8,713 chicks largely bred for egg production was made to determine the relation of down pigmentation to sex and to adult color.

Only about 10 percent of male chicks showed any color markings in the down as compared with about 44 percent of female chicks that showed spotting or striping. In the total population only 26.76 percent of the chicks had spots or stripes in the down.

In the male chicks 4.47 percent had black pigmented areas and 5.66 percent had brown pigmented areas; in the females 27.53 percent had black pigmented areas and 16.62 percent had brown.

The prevailing type of pigment area was a spot on the head. In the population with pigmented down, black was confined to the head as often in males as in females. Brown pigment spots were slightly more common in male chicks in the population showing pigment spots. When chicks were striped the color of pigment was more likely to be black.

Considering only the marked population, about 15 percent of the chicks with black pigment were males and about 26 percent with brown pigment were males.

Adult color in males averaged slightly lighter than in females.

Chicks of both sexes that carried some black pigmented areas developed a slightly darker adult plumage color and fewer mottled individuals than chicks with solid down color or with brown pigmented areas.

Color markings in down has no commercial value as an indicator of sex in the stock studied.