AUTO-SEX LINKAGE IN THE DOMESTIC FOWL

Modifiers of the Gene for Barred Feathers

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In the domestic fowl the dominant sex-linked gene, Z^B, places white bars across colored feathers. Two of these genes, Z^BZ^B, increase the width of the white bars. Since the female is the heterogametic sex in the fowl it has only one barring gene, Z^BW, and as a result, has narrower white bars than a homologous male. The resultant sexual dimorphism is primarily genic in contrast with the more common type which is under hormone control.

The common breeds of fowl exhibiting barring of the feathers are fundamentally self black in color. The superimposed barring results in white bars on a black background. At hatching, chicks of these breeds are characterized by a light spot in the occipital region of the head. Male chicks, owing to the effect of two genes, tend to have less intense black pigment than the females and a larger occipital spot. Many attempts have been made to identify the sexes at hatching by intensity of pigmentation and size of the head spot. In general accuracy has varied around 80 per cent. Recently Jerome[1] has reported 98 per cent accuracy in distinguishing the sex of 300 Barred Plymouth Rock chicks. In addition to the general pigment reduction, Jerome observed that the head spot of each sex tends to have a characteristic shape. His success in differentiating the sexes is attributed to a knowledge of the sex-limited difference in shape of the occipital spot.

Punnett and Pease[2], studying the interaction of autosomal and sex-linked barring of the feathers, transferred the Z^B-gene into a soma in which the melanic pigment had already been restricted. As a result of this particular combination of modifying genes all homozygous, Z^BZ^B, male chicks were phenotypically much lighter colored than their homologous sisters, Z^BW. Since the industry had already used sex-linked genes for segregating male and female crossbred chicks, this new phenomenon was entitled "sex-linkage within a breed." Recently a more appropriate designation, auto-sex linkage, has been generally accepted. Pease[3] and Hagedoorn[4] have transferred the barring gene into other partially black varieties. Pease indicates that a sharp distinction exists between males and females when the basic down color pattern is striped.

To be commercially valuable auto-sex linkage must be distinct at hatching. For use in research work there must be a definite phenotypic demarcation between the sexes at all ages. For these reasons the Oklahoma Agricultural Experiment Station has undertaken a study of the most suitable modifiers of the barring gene. Three true-breeding down colors were chosen. All three of these are in what is known as the "gold" color series and are found in a true-breeding form in certain Standard[5] breeds.

Two of the chosen down colors usually lack pattern, being relatively uniform over the dorsal surface of the chick. Since the Rhode Island Red variety breeds true for the lighter color tone in the down this has been designated red. The darker type is similar to that of the Partridge Plymouth Rock and being an intense brown will be termed mahogany. The

third form is intermediate in tone and characterized by definite longitudinal stripes. The Light Brown Leghorn breeds true for this color pattern.

During the past four years these down colors have been combined with barring to produce parents whose progeny would segregate into these three types. This provided three comparable groups differing only by the three basic down colors. Sex was tentatively determined at hatching and verified at about 16 weeks of age.

In this study data from 176 chicks are available. Of these 109 were basically striped, 32 red and 35 mahogany. In the striped class the 54 females and 55 males were distinctly different from each other. This demonstrated that in basically striped chicks two genes for barring always produce a much lighter colored down than does one barring gene.

There was considerable intergrading between the colors of the male and female chicks in the red and mahogany downs. The sex of three chicks in the red group and five in the mahogany was determined incorrectly at hatching, demonstrating that striped down color in the "gold" color series is preferable for auto-sex linkage. Whether the striped down in the "silver" series will be equally suitable remains to be tested. Pease[3] has suggested it as a possible alternate for "gold" striped in accurate auto-sex linkage.

One of the wild jungle fowl, *Gallus bankiva*, is supposed to be a progenitor of the domestic fowl. At hatching this jungle fowl has the striped form of "gold" down color. Assuming that the gene producing this auto-sex linked difference arose by mutation in the wild form such a mutation would be considered due to a sex-linked recessive gene, two genes being necessary for its expression at hatching. Additional mutations increasing the intensity of the melanic pigment in the down allow one gene to produce the characteristic. This is the common form in which it is found and barring is, therefore, considered a sex-linked dominant character. It is this type of change from which Fisher[6] has proposed the theory of evolution of dominance. Fisher has transplanted the barring gene into the *bankiva* soma by a number of backcrosses. The result has been similar to that just described. In the down the gene becomes completely recessive. In adult plumage the effect of one gene may be obscured only in very pale forms designated as "buff" downs.

[1] Jerome, F. N., 1939. Auto-sex linkage in the Barred Plymouth Rock. Poult. Sci., 18; 437.

[2] Punnett, R. C. and M. S. Pease, 1930. Genetic studies in poultry. VIII. On a case of sex-linkage within a breed. Jour. Genet., 22; 395.

[3] Pease, M. S., 1936. Auto-sex linkage in theory and practise. Vi. Weltgeflugelkongresses sektionsmitteilungen, p. 65.

[4] Hagedoorn, A. L., 1936. The autosexing Barnevelder, and the autosexing Leghorn, two new breeds. Vi. Weltgeflugelkongresses sektionsmitteilungen, p. 29.

[5] The American Standard of Perfection, 1938, published by the American Poultry Association, Fort Wayne, Indiana.

[6] Fisher, R. A., 1930. The genetical theory of natural selection. Clarendon Press, Oxford.