# Genetic determinism of feather color in ROSO SL-2000 hybrid layers

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## Abstract

*The experimental and production results obtained with ROSO SL-2000 hybrid show that the color range of day-old hybrid chicks resulted from silver and golden parents is due to the genes from the heterosomal locus silver/golden.*

**Keywords:** *genetic determinism, feather, color, ROSO SL-2000 hybrid*

## Introduction

Classically, the production of commercial hybrids producing eggs with pigmented shell is based on the biracial crossing: pure, red Rhode Island cocks for golden gene (simple AB-hybrid parent of father) with pure, white Rhode Island hens for silver gene (simple CD-hybrid parent of mother) – Figure 1.

The color of day-old chicks down is a trait controlled by genes situated on sex chromosomes (Bălăşescu *et al.*, 1980; Dinu Viorica, 1971; Drăgănescu, 1979; Negruţiu and Petre, 1975; Pipernea, 1979; Pricop *et al.*, 1996, 1998, 1998; Sandu, 1983; Sandu *et al.*, 1999; Ţârlea, 1976).

The literature shows that commercial hybrids can be sexed after the color of day-old down on condition that the fathers are homozygous for the golden gene and the mothers hemizygous for the silver gene. Compared to the pure lines and parental forms that completely white (silver) or red (golden) when day-old, in the commercial hybrid day-old chicks, color variations appear, predominant being white color phenotypes in males and white-red phenotypes in females with ember-red on the head and two red stripes on the back (phenotype 1 from Figure 2 – males and females).

The purpose of this paper is to establish the scientific grounds for the manner of interaction of silver and golden genes situated on the same heterosomal locus.

## Material and method

The present study was conducted in S.C. AVICOLA Bucureşti, S.A. The stock of Rhode-Island parents (AB cocks × CD hens) produced eggs which were used for two hatching batches.

A total of 10,000 eggs were used for each batch.
From each batch we obtained 8,000 double hybrid chicks that were sexed by the feather color (Table 1).
The accuracy of sexing was assessed using the cloaca method.

## Results and discussion

The homogametic sex was marked XX and the heterogametic sex was marked XY.
a) *Down color*
Table 1 shows the results of sexing the hybrid day-old chicks produced by the two batches.
Figure 2 shows the color types and their frequency by sex in the commercial hybrid ROSO SL-2000.
Three types of color were observed in day-old cocks and four types of color in the day-old hens. In males, the color types were: fully white (86.6%), white with dark brown spot on the head and three dark brown stripes on the back (3.4%) and white with brown spot on the back (10%). In females the color types were: white-red with ember-red on the head and two red stripes on the back (90.4%), white-red with ember-red on the head (2.4%), red with dark brown spot on the head and three dark brown stripes on the back (1.4%) and fully red (5.8%).
The color of down in day-old cocks is preponderantly white (86.6%) but we can not talk of a complete dominant because there are two more phenotypes (2 and 3), as shown in Figure 2, which suggests that this trait is different from that of the parents.
When day-old, all parent cocks have red down and all parent hens have white down.
The results of our investigations show that in the genetic determinism of transmitting the down color to hybrid cocks with phenotypes 2 and 3 (13.4% cumulated frequency), the action of golden and silver genes is CODOMINANT.
The color of down in day-old hens is preponderantly white-red with ember-red on the head and two red stripes on the back (90.4%). This color is different from that of day-old parents, which is completely red in cocks and fully white in hens, which shows the lack of the dominant.
The hybrid hens are heterozygous (golden/silver).
It may be observed in the four color types (Figure 2) that the down is white-red and in phenotype 4 the down is fully red (5.8%). Compared to the white down cocks, in hens the action of silver gene is cancelled by a heterosomal epistatic gene located on a locus on chromosome Y. This gene provides the silver gene (situated on a locus also on chromosome Y) the role of hypostatic gene and under

these conditions it does nit display phenotypically the effect for a limited period (4-5 weeks).

b. *feather color*

The evolution of feather color was monitored in ontogentically in the hybrid chicks.

The color of white cocks started to change at four weeks of age. Thus, red feathers appear besides the white feathers and the small hooks become yellow-red.

A large variety of red feathers was observed but phenotypically they are present in all adult cocks concomitantly with the presence of yellow-red small hooks.

The mixture of white and red feathers in the hybrid cocks resulted in a flower-like color, intermediary (different) to parent feather color (Figure 3).

Besides the silver gene, the golden gene located on the other X sex chromosome in cocks also displays its effect, which shows a CODOMINANT action of silver and golden genes.

In the hybrid hens with white-red day-old down, the adult feather color is no longer dark red as in the parent cock, but lighter, with some white feathers.

Figure 3 shows that the hybrid hens have a different phenotype than that of the parents: white feathers appear, while the small hooks are yellow red.

The phenotype of hybrid hens is different from the phenotype of hybrid cocks because the heterosomal epistatic gene inhibiting the activity of the silver gene displays its effect throughout the ontogenic period. Under these conditions, the silver gene being hypostatic, the hybrid hens have preponderantly red feathers compared to the hybrid cocks.

The presence of the silver gene on chromosome Y has correspondence both in the white feathers and in the yellow-red small hooks observed in the hybrid hens.

The difference of color between cocks (XX) and hens (XY) is to the advantage of the heterogametic sex because the silver gene is situated on a locus on chromosome Y and the heterosomal epistatic gene inhibits largely its effect. Under these circumstances the golden gene situated on a locus on the sex chromosome X is displaying preponderantly its effect and we observe phenotypically that the hens have mostly red feathers, with some white feathers too.

The color differences between the two sexes are given by the place of silver and golden genes on the heteromoses.

a) The parents used in the hybridization design (Figure 1) produce only one category of hybrid offsprings (hens and cocks) with red

and white feathers, whose phenotype is intermediary (different) compared to that of the parents.
b) Having different genotypes, the parents are homozygous on different genes (the cocks have GG phenotype and the hens have SS phenotype).
c) Being homozygous on different genes, each parent transmits another gene to its offspring, through the gametes.
d) The resulting offsprings (hybrids) are HETEROZYGOUS (GS genotype).
e) Because the offspings are heterozygous and have an intermediary (different) phenotype compared to the parents, the DOMINANT LACKS in feather color transmission.
f) Because there is no dominant, genes silver and gold are CODOMINANT.
g) The fact that two genes are CODOMINANT cancels the result of earlier investigations assessing gene golden as recessive in relation with gene silver (dominant).

## Conclusions

The genetic determinism of down and feather color in the commercial hybrid ROSO SL-2000 is achieved through the heterosomal genes silver (S) and golden (G).
Gene silver (S) is not dominant in relation with gene golden (G), the two genes being CODOMINANT.
Our investigations confirms the presence of gene silver on chromosome Y in hybrid hens; both chromosome Y and gene silver were transmitted on line D (Figure 1).
Gene silver, considered so far dominant in relation with gene golden, displays preponderantly its effect only in cocks, on a limited period during ontogeny (during the first four weeks of life).
Despite the fact that it has the same period of competence as golden gene, we observed in the hybrid hens that silver gene plays the role of hypostatic gene due to the action of a heterosomal epistatic gene situated on a locus on chromosome Y. The action of the epistatic gene on gene silver allows golden gene to express its phenotypic effect by the preponderantly red feathers of the hybrid hens.
The genetic determinism of gene silver in the transmission of feather color is observed by the white feathers and the yellow-red lanțete of the hybrid hens.
The transmission of feather color in ROSO SL-2000 hybrid through genes silver and gold, corroborated with the presence of gene silver on chromosome Y in hens, contradicts, at least in this case, the existence of hemizygous hens.
The genetic determinism of down and feather color was monitored during the growth of hybrid offsprings from day-old (down color)

to the stage of adults (feather color) in order to observe the color changes. In ROSO SL-2000 hybrid there was no phenomenon of dominance between genes silver and golden.
This contradicts the results of earlier investigations assessing that gene golden is recessive, the two genes golden and silver being CODOMINANT.
The investigations confirmed the presence of gene silver on a locus on chromosome Y, which corresponds with gene golden on the same locus on chromosome X in hybrid hens.
Our investigations confirm the presence of golden/silver locus on sex chromosomes X and Y and implicitly of gene silver on chromosome Y, gene involved in the genetic determinism of feather color in the hens of the commercial hybrid ROSO SL-2000.

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**Table 1** *Color types by hatching and sex in day old ROSO SL-2000 hybrid chicks*

| Sex | | Down color | 1st hatching | | 2nd hatching | | Total | |
|---|---|---|---|---|---|---|---|---|
| | | | Chicks | % | Chicks | % | Chicks | % |
| Male | 1 | Fully white | 3452 | 85.7 | 3476 | 87.50 | 6928 | 86.60 |
| | 2 | White with dark brown spot on the head and three dark brown stripes on the back | 145 | 3.60 | 127 | 3.20 | 272 | 3.40 |
| | 3 | White with brown spot on the back | 431 | 10.7 | 369 | 9.30 | 800 | 10.0 |
| Total | | | 4028 | 100 | 3972 | 100 | 8000 | 100 |
| Female | 1 | White-red with ember red on the head and two red stripes on the back | 3600 | 90.63 | 3632 | 90.17 | 7232 | 90.40 |
| | 2 | White-red with ember red on the head | 92 | 2.31 | 100 | 2.48 | 192 | 2.40 |
| | 3 | Red with dark red spot on the head and three dark brown stripes on the back | 53 | 1.34 | 59 | 1.47 | 112 | 1.40 |
| | 4 | Fully red | 227 | 5.72 | 237 | 5.88 | 464 | 5.80 |
| Total | | | 3972 | 100 | 4028 | 100 | 8000 | 100 |