The role of the B locus in the genetics of color in rabbits (*Oryctolagus cuniculus*)

[1,2]Marian Proorocu, [3]Eniko Kovacs

[1] Department of Environmental Engineering and Protection, Faculty of Agriculture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania; [2] Enviromep SRL, Colonia Făget, Cluj, Romania; [3] Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Cluj-Napoca, Romania. Corresponding author: M. Proorocu, mproorocu@yahoo.com

Abstract. We propose in this work to present in a simple manner (with data from literature, or personal observation) the role of the B locus in the genetics of color in rabbits. B locus determines the presence or absence of black pigment in the coat. The dominant allele B produces black pigment, while the recessive allele b produces non-black pigment. The B locus is not of particular relevance considered alone, but considered together with other loci, it is very important in the work of selecting the color and shade of the coat of domestic breeds bred for show.
Key Words: coat color, rabbit, *Oryctolagus cuniculus*, black, brown, chocolate, havana.

Introduction. The creation of rabbit breeds would have been impossible without knowledge, at least empirically, of how traits are transmitted from one generation to another (Botha et al 2013; Petrescu-Mag et al 2014). The genetics of coat color in rabbits (*Oryctolagus cuniculus*) is a very complex one due to the multitude of varieties of shape and color observed in domesticated breeds (Bud et al 2011; Dai et al 2022). We propose in this work to present in a simple manner (with data from literature, or personal observation) the role of the B locus in the genetics of color in rabbits.

Genetics of coat color in rabbits. There are several loci that are known to influence coat color in rabbits. The most important of these are the following.
A locus: Determines the presence or absence of agouti banding, which is the pattern of alternating light and dark bands of color seen in many wild rabbits. The dominant allele A produces agouti banding, while the recessive allele a produces a solid color (Papuc & Petrescu-Mag 2021).
B locus: Determines the presence or absence of black pigment in the coat. The dominant allele B produces black pigment, while the recessive allele b produces non-black pigment (usually brown or gray) (Fontanesi 2021a).
C locus: Determines the presence or absence of color dilution. The dominant allele C produces normal coloration, while the recessive allele c produces dilute coloration (Covrig et al 2013).
D locus: Determines the presence or absence of dense or full coat. The dominant allele D produces dense fur, while the recessive allele d produces a lighter, less dense coat (dilute) (Fontanesi 2021a).
E locus: Determines the presence or absence of extension of black pigment (Oroian et al 2020). The dominant allele E produces extended black pigment, while the recessive allele e produces restricted black pigment (usually a lighter, reddish color).
En locus: It is responsible for English spotting (charlie, broken and solid color patterns) (Petrescu-Mag et al 2016).
Du locus: It is responsible for Dutch color pattern (Fontanesi 2021b).
V locus: This locus is so special due to Vienna phenotype (vv), a peculiar case of albinism, where v is a recessive allele at the V locus (Proorocu et al 2019).

W locus: Where the recessive w in homozygote form doubles the production of red pigments.
Si locus: Responsible for the silver (si) color pattern (resulted from Sisi and sisi allele combinations). The case of Si locus is one of incomplete dominance of Si allele over de silvering allele (si) (Gruaz et al 2019).
There are also several other loci that can modify these basic coat colors and patterns (Little 1958).

The B locus. The B locus in rabbits is responsible for determining the color of their coat. It is one of several loci that control coat color in rabbits. The B locus has two alleles: B (black) and b (non-black).

Rabbits with at least one B allele will have a black coat, while those with two copies of the b allele will have a non-black coat (generally brown/chocolate). However, there are other loci that can modify the expression of the B locus, resulting in a wide range of coat colors and patterns.

Varieties having B gene include black (self), blue (Figure 1), castor (black agouti), and opal (black dilute agouti). Black rabbits can be BB and Bb (Table 1). If a rabbit is Bb it will hide the recessive chocolate gene. Chocolate gene (b) is recessive in the B locus, so it is expressed only in the form bb. Varieties having a pair of b alleles (bb) include chocolate (Figure 2), lilac, amber (chocolate agouti), and lynx (chocolate dilute agouti).

In addition to coat color, the B locus can also affect other pigments in the rabbit's body, such as the color of the eyes and the pads of the feet. For example, rabbits with the B allele will typically have brown eyes and black pads, while those with the b allele may have blue or gray eyes and pink pads.

Figure 1. Two color patterns having the B allele: black (left) and blue (right, in this particular case: blue Papillon) (photo: Miklos Botha, via Ioan Valentin Petrescu-Mag).

The B locus is important for rabbit breeders who want to produce rabbits with specific coat colors or patterns. By selecting rabbits with the desired alleles at the B locus and other relevant loci, breeders can create rabbits with a wide range of colors and patterns.

Figure 2. Brown, known also as chocolate or havana color pattern, having a pair of b alleles (bb) (photo: Iepuri Pitici de Companie - Facebook).

Table 1

Complete dominance relationship in the case of the B locus

Alleles	*B – dominant black*	*b – recessive brown*
B – dominant black	BB - black	Bb - black
b – recessive brown	Bb - black	bb – brown (chocolate, havana)

Conclusions. The B locus is not of particular relevance considered alone, but considered together with other loci, it is very important in the work of selecting the color and shade of the coat of domestic breeds bred for show.

Note. In this paper we use the English notation system of genes, and not the German one (Botha et al 2011).

Conflict of interest. The authors declare no conflict of interest.

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Authors:
Marian Proorocu, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Agriculture, Department of Environmental Engineering and Protection, 3-5 Calea Mănăştur Street, 400372 Cluj-Napoca, Romania, e-mail: mproorocu@yahoo.com
Eniko Kovacs, Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Calea Mănăștur 3-5, 400372 Cluj-Napoca, Romania, e-mail: eniko.kovacs@usamvcluj.ro

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