Laranja—an additional eye color gene in the snow series of *Apis mellifera* L.

Ademilson Espencer Egea Soares and José Chaud Netto

**Abstract:** Three different instrumental inseminations were carried out using drones and queens bearing the mutant genes *la* and *s*. Phenotypic analysis of worker progeny from these crosses as well as analysis of drone progeny produced by one heterozygous queen revealed that the *la* and *s* genes are alleles. Thus the *la* gene belongs to the snow (*s*) series, with suggested symbol *s*. In his later work with laranja, Woyke determined that it is not allelic or linked to *brick* (*bk*), *chartreuse* (*ch*), *garnet* (*g*) or *umber* (*u*).

Chaud-Netto observed that the *la* gene segregates independently of the *cd* (*cordovan*) marker, giving the yellow coloration to the male, *ch* (hairless), and *ch* (chartreuse-red).

Recently, with the purpose of maintaining the existing mutations in the mutant stock of the Department of Genetics of the Faculty of Medicine of Ribeirão Preto, we carried out a controlled crossing by artificial insemination of a queen heterozygous for the laranja (*la*) gene with snow-tan (*s*) males. The worker progeny showed two phenotypes for eye color: some were born with red eyes and others with dark eyes. This observation strongly suggested that the two genes may be alleles, a fact that could be proven with further crossings.

**Methods and Results**

A comb with bees ready to emerge was taken from the nucleus where the samples for phenotypic analysis were to be collected. It was then placed in a cloth frame (emergence cage) and transferred to an incubator with controlled temperature and relative humidity. As the workers emerged, their eye color was observed.

Two types of workers were obtained in the *F*1 of the first cross (*queen *la*/*+* × *drone *s*), some with reddish eyes (*la*/s') and others with dark eyes (*+/s*). The proportion was nearly 1:1, as demonstrated by the chi-square test (Table I).

Although it was presumed that the laranja gene is a new allelic gene of the snow series, we carried out two more crosses for definite proof of this fact. Thus, a queen with reddish, and supposedly heterozygous between the laranja and snow genes (*la*/s'), was crossed initially with snow-tan (*s'*/*s*/*s') males. Workers with reddish (*la*/s') and white (*s'*/*s*/*s') eyes were obtained in equal proportions in *F*2, as demonstrated by the chi-square test (Table I).

A queen with reddish eyes, heterozygous for the laranja and snow genes (*la*/s'), was then crossed with laranja males. Although the *F*2 workers had two distinct genotypes, it was practically impossible to separate the two phenotypes because all workers had red eyes. Analysis of the drone progeny of this queen (*la*/s') once more showed that the laranja and snow-genome are indeed alleles, since no black-eye drones emerged, and no color other than snow or laranja was observed, presumably resulting from the interaction of the nonallelic *la* and *s* genes (Table I).

<table>
<thead>
<tr>
<th>Genotypes of parents</th>
<th>Phenotypes of progenies</th>
<th>x²</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>la</em>/<em>+</em> × <em>s</em>/<em>+</em></td>
<td><em>workers</em>: 360, dark eyes; 344, reddish eyes</td>
<td>0.38</td>
</tr>
<tr>
<td>2 <em>la</em>/s'/<em>+</em> × <em>s</em>/<em>+</em></td>
<td><em>workers</em>: 673, reddish eyes; 711, snow eyes</td>
<td>0.34</td>
</tr>
<tr>
<td>3 <em>la</em>/s'/<em>+</em> × <em>s</em>/<em>+</em></td>
<td><em>workers</em>: all reddish eyes; <em>drones</em>: 756, orange eyes; 784, snow eyes</td>
<td>0.51</td>
</tr>
</tbody>
</table>

* The mating does not affect drone progeny. The counts do not differ from the expected gametic ratio at 0.10 level of probability.

---

**References**


